Louisiana State University
LSU Digital Commons

LSU Historical Dissertations and Theses
Graduate School

1997

The Impact of Training Content Validity, Organizational Commitment, Learning, Performance Utility, and Transfer Climate on Transfer of Training in an Industrial Setting.

Reid A. Bates
Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation

Bates, Reid A., "The Impact of Training Content Validity, Organizational Commitment, Learning, Performance Utility, and Transfer Climate on Transfer of Training in an Industrial Setting." (1997). *LSU Historical Dissertations and Theses*. 6382.
https://digitalcommons.lsu.edu/gradschool_disstheses/6382

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

THE IMPACT OF TRAINING CONTENT VALIDITY, ORGANIZATIONAL COMMITMENT, LEARNING, PERFORMANCE UTILITY, AND TRANSFER CLIMATE ON TRANSFER OF TRAINING IN AN INDUSTRIAL SETTING

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The School of Vocational Education

by
Reid A. Bates
B.A., University of Iowa, 1975
M.S., Oregon State University, 1991
May 1997

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UMI Number: 9735977

Copyright 1997 by
Bates, Reid A.

All rights reserved.

UMI Microform 9735977
Copyright 1997, by UMI Company. All rights reserved.

This microform edition is protected against unauthorized
copying under Title 17, United States Code.

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

© copyright 1997 by Reid A. Bates,
all rights reserved

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

ACKNOWLEDGMENTS

This study was made possible by the efforts and cooperation of many people. First, I extend special thanks to my major professor and committee chairperson, Dr. Ed Holton, for challenging my assumptions when needed and for providing the guidance, support, and invaluable insights that made this a better study. I wish to express sincere appreciation to the members of my doctoral committee for their support in this endeavor: Dr. Satish Verma, Dr. Donna Redmann, Dr. Eugene Kennedy, and Dr. Michael F. Burnett. I am thankful for the numerous discussions with my colleague, Dian Seyler, that provided ongoing theoretical and technical clarifications. I am grateful to Dr. Lynn LaMotte for providing key insights into the variable selection process in regression analysis. I am also indebted to the members of the CATS design team for their assistance throughout the implementation of this study.

Most importantly, I am deeply grateful to my wife, Gwenn, whose love, understanding, faith in my abilities, and encouragement were the keys to my sustenance. And lastly, a heartfelt thanks to my son, Augustus, who waited until this project was finished to cut his teeth.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

TABLE OF CONTENTS

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

LIST OF TABLES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

LIST OF FIGURES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

ABSTRACT

The goal of the present research was to contribute to an understanding of the transfer of training process. This study used a conceptual model based on a comprehensive training evaluation model to examine the extent to which secondary influences on training effectiveness, motivational elements, environmental elements, ability/enabling elements, and learning from computer-based training were associated with and explained the variance in supervisory ratings of performance. Subjects were production operators in a Fortune 500 size petrochemical manufacturing firm.

This study examined a revised conceptualization of transfer climate, one in which transfer climate variables were determined based on their referent or source in the work environment. As a set, transfer climate variables were shown to account for the largest proportion ($R^2 = .36$, $p \le .001$) of the variance in performance ratings. Of seven climate dimensions measured, the most powerful predictors of performance to emerge were interpersonal climate dimensions. Peer support, group resistance to change, and supervisor sanctions all emerged as significant predictors of performance. These findings strongly suggest that interpersonal transfer climate dimensions such as work group members belief about themselves as a group, normative expectations about group members work behavior, and supportive interpersonal relationships are highly influential factors dictating the use of training on the job.

Results also showed that content validity was (a) positively and significantly correlated ($r = .53$, $p \le .001$) with performance utility; (b) correlated

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

to a lessor degree with performance ($r = .18$, $p \leq .08$); and (c) a significant predictor of performance ($\beta = .44$, $p \leq .001$) in a regression model. In terms of the conceptual model used for this study, the results suggest that content validity may be appropriate as a secondary variable influencing performance through its motivational value as well as an ability/enabling variable influencing performance directly.

The results of this study provide partial support for a conceptual model based on Holton's (1996) comprehensive training evaluation and measurement model. The findings suggest that only through the use of comprehensive, integrated models of the training process can the cause and effect of training success or failure be reliably identified.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER I: INTRODUCTION

In the last decade training and development activities have become a major focus of organizations. One impetus behind this trend has been the need for improved human performance as a requisite for gaining and maintaining a competitive position in an increasingly dynamic marketplace (Craig, 1987). New technologies and changing work processes have also prompted a need for increased training so that employees can keep pace with continuous workplace changes and innovations (Howell & Cooke, 1989). For example, persistent manufacturing improvements in the petrochemical industry have resulted in an almost continuous change in daily work procedures and have created a significant need for ongoing employee training and retraining. In addition, manufacturing organizations involved in the management and use of hazardous and toxic substances are demanding more and better training not only for the sake of productivity, employee safety, and the safety of the communities in which they operate but also to avoid massive fines and to comply with strict Occupational Health and Safety Administration (OSHA) training and certification mandates.

These examples are reflective of a rising trend of corporate spending on training. For instance, in 1995 an estimated $52.2 billion was budgeted for direct costs of formal training by US employers (Lakewood Research, 1995). With the inclusion of indirect costs the figure rises to over $300 billion (Robinson & Robinson, 1995). An additional $90 to $180 billion is estimated to be spent annually on informal on-the-job training (Broad & Newstrom, 1992).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

This level of expenditure clearly reflects a changed perspective on the value of training interventions: Many organizations that traditionally viewed training as something that had little bottom-line impact and was part of the cost of doing business, today see these activities as a key investment capable of boosting productivity and profits (Broad & Newstrom, 1992).

The rising expectations with regard to training are further reflected in two key developments in human resource development (HRD) practice. First, organizations and HRD professionals have acknowledged the critical importance of linking training objectives directly to organizational goals and strategies as a means of establishing training effectiveness (Peery & Salem, 1993). This assures that if training is designed to increase a specific dimension of job performance, the increased performance will contribute to the goals of the organization (Campbell, 1988). Second, increasing global and domestic competition, rising corporate expenditures, together with demands by consumers for high quality products and service has driven a need for more cost effective training programs and greater accountability for resources used and results produced (Thorland-Oster, 1987). Training activities are therefore under increasing pressure to be evaluated not only on their ability to elicit positive reactions from trainees and show evidence of learning, but also on the extent to which they are able to improve human performance and to show a bottom-line result, i.e., a positive return on investment (Holton, 1996).

Training alone, however, will do little to increase individual or organizational performance unless what is learned as a result of training is

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

transferred into on-the-job behavior. Unfortunately, research has documented that large numbers of employees do not apply learned knowledge, skills, and abilities (KSAs) when they return to the workplace (Baldwin & Ford, 1988; Noe, 1986). Such findings have led to estimates that as little as 10% of the investment in training pays off in performance improvements (Garavaglia, 1993; Kelly, 1982; Newstrom, 1986). The dramatic discrepancy between what is learned and what is applied on the job represents a massive transfer problem (Ford, 1994) so pervasive that rarely is there a learning-performance situation in which such a problem does not exist (Broad & Newstrom, 1992). Indeed, difficulties with transferring training to the job is the most frequently cited reason why training fails (Newstrom, 1986).

Knowledge is limited about when, why or how the dynamics of training transfer work. Moreover, a review of training research revealed that most of the studies evaluating training success only measured learning at the end of training, not on-the-job performance (Baldwin & Ford, 1988). These factors, together with heightened expectations and accountability tied to training and the pervasiveness of the transfer problem, have established a critical need for organizations and HRD practioners and researchers to focus on measuring, studying, and gaining a greater understanding the training transfer process (Hastings, Sheckley, & Nichols, 1995; Noe & Ford, 1992). Without greater insight into the complex relationships between training inputs and the application of learned KSAs in the workplace, transfer problems will continue to be an obstacle to organizations seeking superior performance.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Background of Study

The prediction of transfer from one task to another has long occupied researchers (Cormier & Hagman, 1987; Saloman & Perkins, 1989) and has touched a variety of disciplines from instructional psychology to motor learning to human resource development. Early research into training design approaches to transfer typically emphasized incorporation of learning principles such as (a) identical elements (Thorndike & Woodsworth, 1901); (b) transfer through general principles (Bass & Vaughn, 1966); (c) stimulus variability; or (d) specification of various conditions of learning that promote mastery and retention such as massed or distributed learning (e.g., a single long session or a series of shorter sessions over a period of days or weeks), whole versus part learning, feedback content and timing, and over-learning (Baldwin & Ford, 1988; Campbell, 1988).

There are a number of basic and applied research questions about specific design dimensions such as these that have not been adequately addressed in the literature. Noe & Ford (1992) note that little is known about dimensions of similarity or which elements in the training setting are key when applying principles of identical elements or stimulus variability to the design of training for transfer. Some researchers (e.g., Berkowitz & Donnerstein, 1982), for example, have suggested the physical characteristics of a particular situation may be less important than the psychological characteristics (e.g., the meaning that individuals assign to the situation they are in and the behavior they are carrying out).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Research into the impact of training design factors on transfer has also failed to address questions surrounding the association of training content validity and transfer of training. Some authors have remarked on the extent to which transfer of training literature has ignored the issue of content validity or the perceived job relevance of training materials (Baldwin & Ford, 1988; Garavaglia, 1993; Laker, 1990). The highest priority issue with regard to training, "what is to be learned?" (Gagne, 1962), therefore seems to have been overlooked in the transfer literature. This is important because, from a transfer perspective, there is little incentive (or opportunity) for trainees to transfer learning that is largely irrelevant to job performance. Since content validity and job utility has so long been assumed rather than verified, researchers should "provide evidence of the job relevance of training material before examining the effects of other factors on transfer" (Baldwin & Ford, 1988, p. 99).

Recent advances in cognitive and instructional psychology have benefitted training design by providing some understanding of how trainees acquire knowledge and learn skills. For example, research focused on the stages of skill acquisition (Anderson , 1987), metacognition (Kanfer & Ackerman, 1989), and mental models and schemata (Brooks & Dansereau, 1987; Howell & Cooke, 1989) has provided concrete insights into how learning during training can be enhanced. Little, however, has been done to examine how and with what effect these and other cognitive factors can be incorporated into training design to facilitate transfer (Tannenbaum & Yukl, 1992).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Another area virtually ignored in the literature is the impact of trainee characteristics in general (Ameel, 1992) and job attitudes specifically on transfer. Job attitudes, for example, can play a significant role in determining how employees view the psychological contract between themselves and the organization in which they work (Steers & Porter, 1991). Determining the impact of specific job attitudes on transfer behavior is therefore seen as a key factor in understanding how to increase the likelihood that performance improvements will occur as a result of training. However, the link between job attitudes and transfer of training has received little if any research attention and, for this reason, the nature of the relationship is not well established (Holton, 1996).

Research indicates that organizational climate, or the shared perceptions of an organizations' formal and informal policies, practices, and procedures (Reichers & Schneider, 1990) can affect employee motivation and productivity (Koppelman, Brief, & Guzzo, 1990). Schneider (1975) suggested that multiple, specific climates may exist in organizations, each with a particular referent. One conceptualization of the manner in which work environment factors affect the transfer of learned behaviors to the job is through a transfer of training climate. A number of authors (Baumgartel & Jeanpierre, 1972; Baumgartel, Reynolds, & Pathan, 1984; Ford, Quinones, Sego, & Sorra, 1992; Glick, 1985; Goldstein & Musicante, 1986; Marx, 1982; Michalak, 1981; Noe, 1986; Noe & Schmitt, 1986; Preskill, 1994) have pointed to the key role that a supportive organizational climate plays in the transfer of training. The construct

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

of transfer climate is seen as a moderating variable in the relationship between the organizational context and an individual's job attitudes and work behavior.

Various work environment factors have been suggested which may affect an individual's ability and motivation to transfer learning to job performance. These variables include group situational constraints (Mathieu, Martineau, & Tannenbaum, 1993) such as tools and equipment, budgetary support, time availability (Peters & O'Connor, 1980; Peters, O'Connor, & Eulberg, 1985); organizational policies (Geroy & Penna, 1995), congruence of training objectives and organizational goals and values (Baldwin & Ford, 1988) organizational feedback environment (Becker & Klimoski, 1989); perceived organizational level support of continuous learning (Tracy, Tannenbaum, & Kavanaugh, 1995); approval of innovation (Baumgartel & Jeanpierre, 1972); perceived support of new behaviors (Noe, 1986); and the degree to which trainees perceive they can choose training program content (Baldwin, Magjuka, & Loher, 1991) or choose to attend training (Hicks & Klimoski, 1987; Mathieu, Tannenbaum & Salas, 1992; Ryman & Biersner, 1991). Also included are individual level factors that may impact transfer such as time availability, lack of feedback (Mathieu et al., 1993), and appropriate rewards (Hand, Richards, & Slocum, 1973; Xiao, 1996); upper management support of training (Huczynski & Lewis, 1980); co-worker support (Hastings et al., 1995; Noe, 1986); supervisor support including goal-setting activities, reinforcement activities, and modeling of behaviors (Baumgartel et al., 1984; Huczynski & Lewis, 1980;

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Rouiller & Goldstein, 1993); and opportunity to practice or apply training on the job (Ford et al., 1992).

Although this quantity of research suggests that transfer of training has been well-studied and points to a range of conditions which could potentially play a role in an organization's climate for transfer, a number of factors indicate that little is known about training transfer and that considerable research is still needed in this area. Many of the studies addressing transfer variables, for example, have studied these variables in isolation from other important variables making it impossible to assess how various factors interact to affect transfer. Thus, the need for studies examining multiple variables such as individual differences and motivational strategies and their impact on training outcomes has been emphasized (Baldwin & Ford, 1988).

In addition, a wide variety of work environment variables have been suggested as important in training transfer but very little work has been done to refine and formulate these variables into viable scales. Many studies have used study-specific, unvalidated scales to measure constructs such as supervisory support, supervisory involvement, training reactions, and other variables. The content of these variables is far from established in the literature yet few, if any, studies have used factor analytic techniques to empirically determine the latent variables or factors which underlie a set of scale items. Serious research is needed to develop the psychometric integrity of instruments designed to measure transfer relevant constructs before more definitive conclusions about the relationship of transfer climate to individual performance

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

outcomes are possible. Bates, Holton, & Seyler (1996a) have therefore suggested that an important goal for transfer researchers is the identification of generic transfer constructs present in every training situation, the identification of accepted procedures for constructing appropriate items and scales to assess those constructs, and the development of validated transfer climate scales. Without generalizable constructs which are validly and reliably measurable, cross study analysis will be very difficult.

In short, despite limited research suggesting the presence of an interpretable work climate structure supporting transfer (e.g., see Rouiller & Goldstein, 1993; Tracy et al., 1995) and the identification of a laundry list of potentially important work environment factors there is little understanding of what constitutes a supportive transfer climate or how to measure it (Baldwin & Ford, 1988; Laker, 1990; Tannenbaum & Yukl, 1992). Many potential transfer climate factors are multidimensional variables whose effects on transfer have been inadequately defined, the reliability and validity of the instruments designed to measure proposed constructs is not well established, and little is known about how different variables impact transfer from one setting to another or at what level of analysis (individual, group, or organization) they operate.

Another recurring issue in the transfer literature which continues to weaken research validity is the lack of adequate criterion measures of transfer behavior. Baldwin and Ford (1988) lamented the almost singular use of self-report data in transfer studies prior to 1988. The transfer studies conducted since then have not improved on the situation: The predominant source of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

information about post-training behavioral change continues to be self-report data.

A number of authors have provided relatively extensive taxonomies of facilitators and inhibitors of the transfer process (Broad & Newstrom, 1992; Robinson & Robinson, 1985; Vandenput, 1973). Others have developed models which recognize the complex, multi variate nature of the transfer process. Huczynski and Lewis (1980), for example, developed a model which illustrated the interaction of course content, trainee motivation, and work environment in the transfer process. Hastings et al. (1995) designed the Strategic Quality Training Model which integrates transfer research findings with principles of total quality management (TQM) into a paradigm intended to support continuous improvement activities. Xiao (1996) developed a model of transfer that viewed training as a developer of a trainee's potential capacity and specified organizational factors (e.g. supervision) as the factors primarily responsibility for enlivening that potential. Goldstein and Musicante (1986) suggested that it is possible to talk about the relationship between laboratory studies of training and training in the workplace based on an analysis of transfer of training dimensions. These authors identified five key factors underlying training transfer (physical similarity of the training site to the job site; psychological process similarity; trainee characteristics; instructional variables; and a supportive work climate) and suggested these variables can be used to assess the generalizability of rater training studies from the laboratory to the field. Campbell (1988) and Baldwin and Ford (1988) have both proposed

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

holistic models of the transfer process which specify a number of training design variables, trainee characteristics, and work environment factors that have the capacity to significantly affect transfer of training. Both models described these variables as having direct and indirect effects on training outputs (i.e., learning) and the generalization and maintenance of learning on the job. An integrated evaluation research and measurement model proposed by Holton (1996) suggested that variables such as those outlined by Campbell and Baldwin and Ford can be involved in a range of complex interactions affecting transfer. However, only limited research has been done to test the propositions explicitly or implicitly proposed by any of these models. As a result, our knowledge is still greatly limited about which factors in the training transfer process have the greatest impact on transfer under various conditions, about the interactions of these factors, or about how transfer might or should be measured (Baldwin & Ford, 1988; Laker, 1990).

It has been observed that the potential for training to play a role in organizational success is limited by the ability of theory and research to keep pace with the expansion and growth of practice (Goldstein, 1989). Transfer of training is a case in point. Although transfer of training has been identified as a key factor in determining the effectiveness of any training intervention (Kirkpatrick, 1987), theory and research has provided only limited knowledge about <u>which</u> factors have the greatest impact on the transfer of training and about <u>how</u> these factors effect transfer behavior under different conditions and different kinds of training. Based on a comprehensive review of the transfer

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

literature, Baldwin and Ford (1988) concluded that transfer research has been largely correlational in nature, focused principally on single input factors presumed to affect transfer, neglected the development of appropriate criterion measures, and failed to develop and test a framework that incorporates more complex interactions among training inputs. Whereas recent reviews (Noe & Ford, 1992; Tannenbaum & Yukl, 1992) indicated that research has begun to take a broader and more eclectic approach to the study of transfer, the current state of the transfer research does not allow a great number of well grounded conclusions (Laker, 1990; Thoms & Klein, 1992). With few exceptions, the transfer research to date has treated transfer as a unitary phenomenon without differentiating alternative mechanisms by which transfer might (or might not) occur, failed to account for intervening variables in the transfer process, or to make predictions about the effectiveness of transfer conditions in other settings.

What is known, however, is that (a) the transfer of knowledge, skills, and abilities learned in training to the job is the major determinant of successful training (Hastings et al., 1995; Tziner, Haccoun, & Kadish, 1991); (b) transfer of training is a complex, multi variate phenomenon that can have a significant impact on individual and organizational performance; (c) there is still much to be learned about critical transfer factors including design issues, the role of job attitudes, measurement of transfer climate, central criterion issues of generalization and maintenance of learning on the job (Baldwin & Ford, 1988), specification of which transfer factors are most important for different kinds of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

training, levels of skill requirements, task complexity, level of trainee ability (both cognitive and psychomotor), and the impact of age, job tenure, and other variables on transfer behavior.

Statement of Problem

Transfer of training has been recognized as a vitally important issue to organizations, HRD practitioners and researchers. If the HRD profession in general and training interventions specifically are going to be able to contribute effectively to individual and organizational performance then developing a deeper understanding of the transfer process is needed. Despite increasing research directed at a range of factors affecting transfer and the development of a variety of theoretical and conceptual models of the transfer process, a number of fundamental questions remain. Most importantly, until the critical dimensions of the transfer equation have been adequately defined, made validly and reliably measurable, evaluated together in context, and interpreted in a theoretical framework, research will offer only marginal assistance in understanding and overcoming the transfer problem.

Statement of Purpose

The purpose of this study is to empirically and systematically investigate variables representing three sets of factors affecting transfer of training behavior: (a) training design factors including training content validity and transfer design; (b) trainee characteristics including performance utility and organizational commitment; and (c) work environment factors including supervisor support, opportunity to use training, peer support, resistance to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

change, supervisor sanctions, positive personal outcomes, and negative personal outcomes.

These three sets of variables represent the three classes of factors (training design, trainee characteristics and work environment) identified by Baldwin & Ford (1988) as impacting training transfer. The present study is an attempt to refine Baldwin and Ford's paradigm by identifying specific variables or latent constructs which contribute to the transfer of training. Therefore, specific variables are defined, measured, and evaluated in terms of both their individual and aggregate contribution to explaining the variance in the performance of employees involved in workplace training.

The results of this study will provide valuable information about the relative importance of individual variables affecting performance, the relative importance of each set of factors and their impact on performance, the relationship between learning and performance, and about the formulation of strategies and practices that can be used to improve training transfer. The conclusions and recommendations emerging from this study will be useful to organizations, HRD practitioners, and researchers in their efforts to enhance individual and organizational performance through the transfer of training, build functional models of the transfer process, and guide future research.

Research Hypotheses

1. Secondary influences on training effectiveness (organizational commitment and content validity) will be positively correlated with performance utility.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Performance utility will be positively correlated with positive transfer climate variables (perceived supervisory support, opportunity to use training, peer support, and positive personal outcomes) and negatively correlated with negative transfer climate variables (change resistance, supervisor sanctions, and negative personal outcomes).

3. Performance utility will be positively correlated with learning.

4. Performance utility, perceived supervisory support, opportunity to use training, peer support, positive personal outcomes, transfer design, and learning will be positively correlated with performance.

5. Change resistance, supervisor sanctions, and negative personal outcomes will be negatively correlated with performance.

6. Organizational commitment will explain a significant proportion of the variance in performance.

7. Content validity will explain a significant proportion of the variance in performance after the variance explained by organizational commitment has been accounted for.

8. Performance utility will explain a significant proportion of the variance in performance after the variance explained by organizational commitment and content validity has been accounted for.

9. Learning will explain a significant proportion of the variance in performance after the variance explained by organizational commitment, content validity, and performance utility has been accounted for.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

10. Transfer design will explain a significant proportion of the variance in performance after the variance explained by organizational commitment, content validity, performance utility and learning has been accounted for.

11. The set of transfer climate variables (supervisory support, opportunity to use training, peer support, change resistance, supervisor sanctions, positive personal outcomes, and negative personal outcomes) will explain a significant proportion of the variance in performance after the variance explained by organizational commitment, content validity, performance utility, learning, and transfer design has been accounted for.

Limitations of the Study

It is important to note some practical and procedural limitations of the study. First, the use of pre-tests for both learning and performance were not possible because of a number of constraints surrounding the training situation including (a) the time pressure on production units to complete the training in order to meet federal certification mandates; and (b) the standard operating procedures (SOPs) which comprised the training were being written while the computer-aided training system (CATS) system was being developed. Consequently, there was neither the time nor information (i.e., the tests) available to conduct learning pre-tests or to develop measures for performance pre-tests. Of course, in the absence of pre-tests it was not possible to determine if there was a gain in learning or performance resulting from the use of computer-based instruction.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Second, a potential control group was lost when one trainee group was unexpectedly given classroom training. The loss of the control group makes it difficult to discount alternative explanations for the effects observed.

Third, the final sample size of the study was significantly reduced by the loss of two large production units who, for various reasons, decided to withdraw from the study. The reduced sample size precluded the use of more powerful statistical techniques to test causal models (e.g., LISREL or path analysis).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER 2: REVIEW OF RELATED LITERATURE

This chapter reviews literature on factors believed to influence transfer of training. A general definition of transfer is offered and the multidimensional nature of transfer is illustrated in the research. An organizing framework to be used in the review of transfer of training research is offered and research relating to specific design variables, trainee characteristics, and work environment factors affecting training transfer is reviewed. Finally, the content, structure, and empirical results of several studies testing proposed models of the training transfer process are reviewed.

Definition and Dimensions of Transfer of Training

In general, transfer of training refers to the degree to which knowledge, skills, and abilities learned in training are applied to the job (Newstrom, 1986; Wexley & Latham, 1981). Thus, transfer occurs whenever learned KSAs affect job performance. This relatively straightforward definition of training transfer masks what many researchers have recognized as a complex, multidimensional construct. For example, transfer can vary from positive (facilitating job performance) to negative (inhibiting job performance), from general (content independent) to specific (content dependent) (Cormier & Hagman, 1987). Transfer can also be characterized along a continuum of distance of generalization from near transfer (the degree to which the stimulus-response dimensions of the transfer task mirrors those of learning task) to far transfer (the degree to which the learning and transfer task stimulus-response dimensions are different) (Butterfield & Nelson, 1989). Transfer is seen as

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

having dimensions of time such as the differentiation between transfer initiation (degree to which the trainee initially attempts to apply learning), maintenance (degree to which the trainee persists in applying learning) (Laker, 1990), and the potential for changes in maintenance of transfer over time (e.g., see Baldwin & Ford, 1988).

Transfer is further distinguished on the basis of the type of task to be transferred. Schmidt and Young (1987) suggested that the primary task for trainees transferring motor tasks is determination of how to produce a given behavior whereas transferring cognitive tasks implies a need to determine what to do. Cormier and Hagman (1987) also believed that distinctions between different classes of behavior (motor, cognitive, and metacognitive) play an important role in a comprehensive understanding of transfer. They noted that, although it is not entirely clear how learning occurs with each of these types of behavior, some research suggests that motor and metacognitive responses are less susceptible to negative transfer than is cognitive behavior (e.g., there is less forgetting). Ignoring the differences in types of behaviors could therefore lead to inconsistent research results and foster misleading conclusions. Gagne (1985) argued that task complexity is a critical dimension of transfer. He distinguishes lateral transfer (performance of a task at the same level of complexity as the task learned) from vertical transfer (performance of a task at a more advanced level of complexity than the task learned). Salomon and Perkins (1989) offered a distinction between low and high road transfer: The former refers to the spontaneous transfer of highly practiced, automatized skills

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

requiring little or no cognition and the latter to transfer requiring "explicit conscious formulation of an abstraction in one situation that allows making a connection to another situation" (p. 118). Yet another distinction is Royer's (1979) identification of literal and figural transfer: Literal transfer is the transfer of intact knowledge and skill to a new task and figural transfer refers to the use of existing knowledge or skills as tools for thinking or learning about new problems.

These distinctions illustrate the multidimensional nature of the transfer and have several important ramifications for training practice and research. For example, different types of training may be concerned with different dimensions of transfer which, in turn, has implications for a wide range of variables influencing both learning and transfer. Laker (1990) noted that training for the acquisition of technical skills, because of its focus on specific skills applicable to the job, emphasizes near transfer. The design for such training may be largely behavioral in nature and the degree of transfer may be more a function of system factors (e.g., degree of task or equipment similarity between training and job environments) rather than person factors (e.g., personality or motivation). On the other hand, management development training may focus on far transfer because of the variance inherent in interpersonal interactions in addition to its potential influence on individual development, organizational goals, or future job prospects (Gielen, 1995). This training may place more emphasis on cognitive processes with the result that transfer may be more a function of person variables such as conditional knowledge (when and where to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

use the skills) or trainee motivation and attitudes rather than system factors. Thus, variations in training content and training objectives impact which dimensions of transfer will be emphasized, all of which can interact with a broad range of other variables (e.g., trainee characteristics, environmental factors) to have an effect on training outcomes.

The extensive range of variables that can affect training outcomes, the complexity of their interrelationships together with the multidimensional nature of transfer makes the study of training transfer a daunting challenge. In order to further advance our knowledge of the transfer process it is necessary, first, to identify and validate as many significant transfer variables as is possible (Gielen, 1995). This requires examination of the accumulated research relating to the impact of individual variables on transfer. A significant advance in this process was taken by Baldwin & Ford (1988). As a result of their comprehensive review of the transfer literature prior to 1988, a functional organizing framework for factors which determine training effectiveness and transfer was developed. Their conceptual model (see Figure 1) proposed that the transfer process consists of training inputs, training outputs, and conditions of transfer.

Conditions of transfer refer to the transfer and maintenance of learning to the workplace. Training outputs are the learning and retention that occurs during training. Training inputs consist of three major classes of factors posited to affect learning and transfer: Training design factors, trainee

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

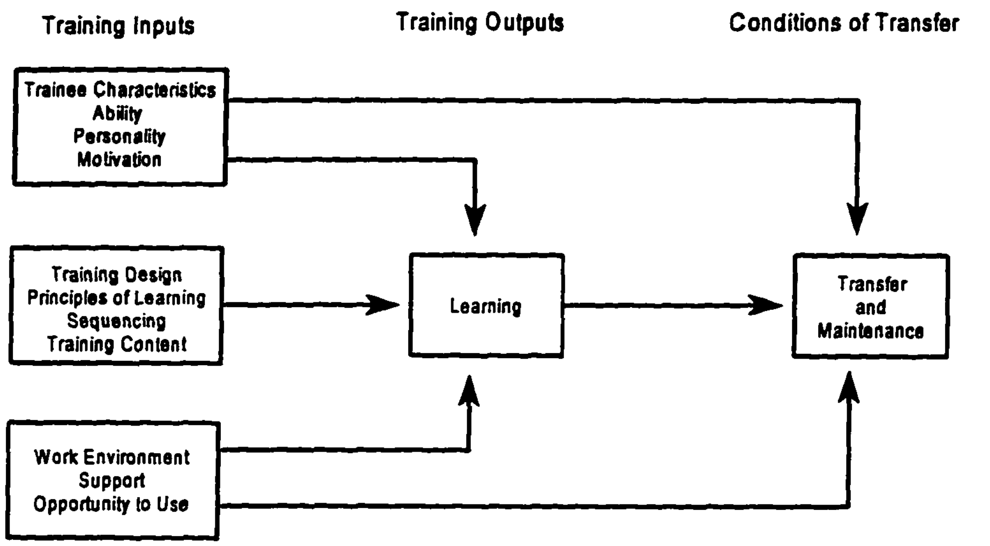


Figure 1: Transfer Process Model (from Baldwin & Ford, 1988)

characteristics, and work environment factors. Training input factors and training outcomes are seen as having both direct and indirect effects on conditions of transfer. The straightforward and encompassing nature of this model makes it a useful for tool for examining research into the factors and underlying processes that affect training transfer. It will therefore be used as an organizing framework for this chapter. The next three sections address each of the three groups of input factors.

Training Design

Instructional Design Approaches to Transfer

Early work on training transfer focused on the use of appropriate instructional design models to aid transfer. Thorndike and Woodworth's (1901) theory of identical elements predicted that transfer occurs when two tasks contain identical stimulus and response elements: The greater the number of shared (identical) elements the greater the amount of transfer. Thus, when

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

stimulus and response elements are identical, the trainee is essentially practicing the transfer task during training and high, positive transfer is expected (Goldstein & Musicante, 1986). Holding (1965) summarized the type of transfer expected based on the type of similarity. Table 1 illustrates the transfer parameters resulting from stimulus-response similarity.

Table 1: Transfer Resulting from the Comparative Stimulus-Response Similarity of Training & Work Tasks (from Goldstein & Musicante, 1986)

Task Stimuli	*Required Response*	*Degree of Transfer*
1. Identical	Identical	High Positive
2. Different	Different	None
3. Different	Identical	Positive
4. Identical	Different	Negative

This approach to transfer is based on the assumption that the structure of the training task determines what is learned and transferred (Gick & Holyoak, 1987). Transfer is predicted on the basis of shared elements with direction of transfer dependent on the functional relationship of response components (Holyoak & Koh, 1987). One major shortcoming of this early conceptualization of transfer was that it provided information only about transfer situations that contain (or do not contain) identical stimulus elements. This limits analysis to near transfer situations, i.e., those where a clear relationship exists between the stimulus elements of the learning and transfer task (Goldstein, 1986). Later work with this theory broadened the concept of identical elements to include degrees of fidelity or similarity (e.g., see Butterfield & Nelson, 1989; Holding, 1991) leading to a focus on stimulus generalizability and encompassing the concept of far transfer.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Stimulus generalization takes place "when a response learned in the presence of a particular stimulus is also elicited in the presence of a similar stimulus" (Royer, 1979, p. 58). This approach to transfer assumes that it is possible to isolate a set of defining stimulus parameters for any transfer situation. Research, however, has shown this to be a very complex issue and has provided little guidance about which elements in the training setting are key. It is clear, for example, that similarity is a multi variate factor that differs in form and meaning from task to task (Baudhuin, 1987) and that some stimulus attributes of the training environment are more important than others (Cormier, 1987). Furthermore, little is known about what factors determine trainee perceptions of similarity (Noe & Ford, 1992).

Other instructional design approaches supporting transfer have also been proposed including (a) general principles, a theory which suggests the key to transfer is identifying and teaching underlying principles so that trainees can apply these principles to performing specific workplace tasks or solving specific problems (Goldstein, 1986); and (b) the conditions of practice model which focuses on issues relating to the distribution of training (e.g., a single long session or a series of shorter sessions over a period of days or weeks), whole versus part learning, feedback content and timing, and overlearning (Campbell, 1988).

Although the considerable research done using the various instructional design approaches to transfer discussed here has increased our understanding of the transfer process (Gist, Bavetta, & Stevens, 1990; Royer, 1979) the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

research has been criticized on several fronts. Issues surrounding the skill content of the studies (e.g., a focus on simple motor or verbal skills not the more complex problem solving and reasoning skills typical of organizational training interventions); the predominant use of student samples; deficient criterion measures of transfer; and the situation specific nature of job performance (Adams, 1987; Baldwin & Ford, 1988. Simon & Roscoe, 1984) all raise questions about the generalizability of these findings to other settings. Training design approaches also overlook the impact of individual differences as well as work environment factors on transfer. These criticisms argue strongly for training designers and researchers to focus attention more specifically on measuring and evaluating the extent to which mechanisms and methodologies that directly address training transfer are included in training design.

Behavioral Modeling. Another instructional design approach that has received some attention in the research literature is behavioral modeling. As a training methodology, behavioral modeling involves the use of live or video-taped model(s) demonstrating behaviors required for job performance (Gist, Schwoerer, & Rosen, 1989). Behavioral modeling training is based on Bandura's (1977) social learning theory and pays particular attention to the role of social observation and imitation of modeled behaviors. Four processes control the modeling training process: (1) attention; (2) retention; (3) motor reproduction; and (4) motivation. The assumption in a typical behavior modeling situation is that, as a result of a trainee observing a model performing

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

the task to be learned, remembering what the model did, and reproducing that behavior in training, the trainee will gain the motivation and ability to transfer training to the job. Failure to transfer behaviors may result from deficiencies in any of these processes (Baldwin, 1992).

Research examining behavioral modeling training has shown this training effective for dyadic interpersonal skills instruction and the application of those skills in the workplace (Burke & Day, 1986; Decker, 1982; Latham & Saari, 1979; Meyer & Raich, 1983; Moses & Ritchie, 1976; Porras & Anderson, 1981) and for computer-software training (Gist et al., 1989). However, there is other research suggesting the presence of a number of subtle process variations involved in behavioral modeling training that can profoundly affect outcomes but which are not yet well understood (Mayer & Russell, 1987). These include the type of retention aids (e.g., rule-oriented or summary written instructions) that accompanies behavior modeling (Decker, 1980; 1982; Mann & Decker, 1984; Robertson, Bell, & Sadri, 1991); type of modeling presentation (e.g., live versus video) (Russell, Wexley, & Hunter, 1984); perceived credibility of modeler (Ilgen, Fisher, & Taylor, 1979); group size (Decker, 1983); and content of modeling display (e.g., combination of positive and negative events) (Baldwin, 1992). There is also research suggesting that the impact of modeling training on transfer behavior is equivocal. Some studies have shown evidence of behavior change on the job as a result of modeling training (Latham & Saari, 1979; Sorcher & Spence, 1982) whereas others have not (Burnaska, 1976; Russell et al., 1984). One interpretation of these findings is that work context

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

factors play a greater role in transfer than does behavior modeling. For example, a review of modeling research by Mayer and Russell (1987) found the involvement of managers with trainees in the training and work settings was a significant confounding factor in much of the behavioral modeling research. Others have suggested the performance effects of behavioral modeling may be a function of practice or opportunity to use learning on-the-job (Gielen, 1995). The effectiveness of behavior modeling as a design approach for enhancing transfer is therefore still open to question.

Training design is and has traditionally been concerned with the appropriateness of instructional content and the form of its presentation. Although the design of training clearly has the potential to influence learning, the research reviewed here strongly suggests that appropriate instructional designs alone are not adequate to insure that what is learned in training will be used on the job. For example, trainees may successfully learn training content but not how to overcome obstacles in the workplace which prevent use of that learning. Given the increasing interest in learning and performance, an appropriate criteria for evaluating training designs, in addition to learning, may be the extent to which trainees acquire the ability to transfer that learning.

Perceived Validity and Job Utility of Training Content

A key aspect of training design is formulating a training program that directly addresses individual and organizational performance problems. How well this is done impacts a number of factors including trainees perceptions of the relevance or content validity of training and the job utility of training

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

(Sleezer, 1993). Perceived content validity refers to the extent to which trainees judge the content of training to accurately reflect job requirements (Holton, Bates, & Seyler, 1996a). Perceived job utility of training refers to the extent to which trainees judge the usefulness of what is taught in training to facilitate workplace goals such as increased productivity, reduced errors, or better problem solving skills (Clark, Dobbins, & Ladd, 1993). Perceived content validity and job utility are thus constructs which measure two dimensions of training relevance.

A number of authors have suggested that the issue of relevance of KSAs taught in training is of critical value in determining transfer (Ameel, 1992; Annette & Sparrow, 1985; Baldwin & Ford, 1988; Garavaglia, 1993). For example, Salomon and Perkins (1989) reviewed a number of studies in which learning transfer did not occur. Based on their findings, the authors suggested that the relevance of instructional content is an important and necessary component of transfer that needs to be complemented by conditions supporting training transfer.

Adult educators (Knowles 1980; 1990; Merriam & Caffarella, 1991) have stressed the importance to adult learners of the relevance and applicability of learning to life roles. Adult learning theory posits that adults are more motivated to devote energy to an activity they perceive will help them perform tasks or solve problems (Cohen, 1990). The implication is that the higher the perceived relevance and utility of training program content, especially for adults learners, the more highly motivated they will be to master that content.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Similarly, expectancy theory (Vroom, 1964) suggests that level of training motivation both to learn and transfer will be positively associated with an individual's expectancy or the subjective probability that effort will lead to an expected outcome. From this viewpoint, both perceived training validity and job utility of training content would be expected to affect training motivation through their influence on perceived usefulness of training. That is, trainees who perceive training content to accurately reflect job requirements and to be useful in reaching desired job goals will be more motivated to learn and transfer that learning.

Several studies provide empirical evidence supporting this position. Huczynski and Lewis (1980) found that two of the three factors that distinguished trainees who attempted transfer from those who did not were (a) a belief that the training would be useful on the job and (b) a belief in the relevance of the course content. Ameel (1992) reported that perceived training relevance was a significant factor explaining the variance in self-reported frequency of training use. Gielen (1995) found that perceived training relevance indirectly supported learning and performance through its association with self-efficacy: Trainees who perceived training as relevant to their jobs had more confidence both in their ability to learn in training and to use that training on the job. Results of other studies have shown that trainees' belief that training was appropriate, will lead to improved job performance (Hicks & Klimoski, 1987) and career opportunities (Clark et al., 1993) was positively related to training motivation.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

A number of important observations emerge from this literature. First, the research supports the potentially influential role of perceived training relevance in establishing the transfer value of training. Second, expectancy theory (Vroom, 1964) presents itself as a useful theoretical approach for explaining the impact of perceived job utility and content validity on trainee motivation and training effectiveness. Third, the results suggest a number of strategies which could enhance training motivation including pre-training interventions aimed at convincing trainees of the value of training (e.g., see Hicks & Klimoski, 1987) or providing supervisors with appropriate training information so they can match training with the job requirements of trainees (Clark et al., 1993). Finally, in spite of the theoretical and empirical support of the utility and relevance constructs, training research and training practice overlook them both when addressing learning and transfer. Most training research appears to implicitly assume the relevance of training content (Baldwin & Magjuka, 1991; Baldwin & Ford, 1988; Laker, 1990) and only a few studies have attempted to measure or verify that training content is perceived as relevant and useful by the trainees. Similarly, a survey of training practices suggested that only a small percentage of organizations conduct any type of needs assessment prior to training (Saari, Johnson, McLaughlin, & Zimmerle, 1988), a key step in establishing training relevance and utility. Research is therefore needed which explicitly examines the relationship between perceived training relevance and utility and training effectiveness.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Extending the Training Paradigm

Wexley and Baldwin (1986) observed that traditional approaches to maximizing transfer (e.g., identical elements, stimulus variability, general principles, overlearning) are not sufficient because they focus only on the period of knowledge or skill acquisition. A number of authors (Cohen, 1990; Noe, 1986; Noe & Schmitt, 1986) have highlighted the need for a more encompassing approach to the training process. Brinkerhoff and Gill (1992) argued for a re-conceptualization of the traditional training paradigm to include a continuum of training activities that supplement classroom training activities and support the maintenance and generalization of learning. Holton (1996) suggested a transfer design construct that refers to the degree to which transfer mechanisms are made a part of the design of training itself.

Transfer Design

Limited research suggests that the incorporation of certain training strategies along with or subsequent to the presentation of instructional content in training programs may enhance transfer. The rationale for these transfer design strategies is that even when relevant learning occurs in training, the skills needed to make the transfer to job behavior may be absent. When trainees are taught how to apply or are given tools or strategies to assist them in applying learned skills then, given proper motivation and positive transfer conditions, greater transfer is a likely result (Holton, 1996). The following approaches hold promise as transfer design strategies.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Goal Setting, Self-Management, and Relapse Prevention. Goal setting and self-management are two approaches to transfer facilitation that have emerged from organizational behavior literature. Goal setting, the process of setting specific, often demanding goals in relation to some performance objective, has been demonstrated repeatedly to be an effective motivational strategy leading to behavioral change in a wide variety of settings (Locke, Shaw, Saari, & Latham, 1981). However, only a few studies have investigated goal setting as a transfer strategy. In a study of a management development program for hospital administrators, Wexley and Nemeroff (1975) found that a treatment group assigned performance goals were significantly better at applying learned KSAs than a control group for which no goals were assigned. Reber and Wallin (1984) compared improvements in safety related behavior as a result of safety training in a farm machinery manufacturing firm. The 56 week long multiple baseline investigation showed that significantly more subjects in the training-with-goal-setting group performed their jobs 100% safely and had fewer on-the-job injuries than did trainees in training-only group.

Behavioral self-management is a process in which trainees are taught strategies by which they can deliberately regulate "stimulus cues, covert responses, and response consequences to achieve personally identified behavioral outcomes" (Luthans & Davis, 1979, p. 43). As a training strategy, this approach focuses on increasing functional behavior and decreasing dysfunctional behavior by helping trainees identify and deal with key interpersonal and job-related stimuli and feelings about those stimuli which

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

inhibit desired behaviors, and by building training-related thoughts and behavioral consequences that support desired behaviors (Tziner et al., 1991; Wexley & Baldwin, 1986). In one of the few studies to examine the effects of behavioral self-management and transfer behavior, Gist et al. (1990) contrasted the effects of goal setting and self-management as transfer strategies in the use of salary negotiation strategies in a simulation. This study used a behavioral measure of performance and found that, after controlling for baseline performance, self-management training resulted in a significantly higher level of transfer than did goal setting. In addition, several studies have examined the impact of self-management training on job performance. Frayne and Latham (1987) studied the effect of self-management training on the work attendance of unionized state government employees. Based on an objective measure of attendance, results showed significant increases in attendance for a treatment group given self-management training when compared with a control group not given such training. The impact on job attendance was still in evidence three months later (Latham & Frayne, 1989).

Relapse prevention, a variant of behavioral self-management, has been forwarded as a potentially valuable transfer strategy for management development training (Marx, 1982). Relapse prevention fosters training transfer by helping trainees understand and cope with the process of relapse, or reversion to pre-training behaviors (Wexley & Baldwin, 1986). This includes, for example, monitoring and learning from past transfer failures, anticipating

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

future problems, and monitoring the use of target behaviors (Noe, Sears, & Fullencamp, 1990).

Only a few studies have examined the role of relapse prevention in training transfer. Tziner et al. (1990) added a relapse prevention module to a two week 'Advanced Training Methods' course for military instructors. Results indicated that trainees who had undergone relapse training showed higher levels of post-training mastery, were more likely to use skill transfer strategies (based on self-reports), and were more likely to transfer skills (based on supervisory ratings). Wexley & Baldwin (1986) compared two types of goal setting (assigned and participatively set goals) with relapse training and a control group in a time-management training course. Results indicated that trainees in both goal setting conditions showed significantly more behavior change (based on self-reports) than did the relapse training or control groups. Noe et al. (1990), using self-report data and single item criterion measures, found that trainees in a relapse training group engaged in more cognitive rehearsal of skill application (e.g., thinking about the skills and identifying opportunities to use skills) than did a control group.

Taken as a whole, this research provides some evidence that goal setting, self-management training, and relapse prevention can positively influence transfer of training. One added advantage of these strategies is that they offer promising additions to the facilitation of transfer insofar as they can be easily included as part of the training design without changing the basic instructional content (Gist et al, 1990). However, because research relating

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

these transfer design strategies directly to performance is limited, and because many of these findings are based on correlational analysis, self-report data, single item measures with small samples, evidence of their usefulness in facilitating transfer must be regarded as only suggestive. More rigorous replication of these results in other settings and with other training content is needed before definitive conclusions about the value and strength of these approaches in promoting transfer can be deduced.

Trainee Characteristics

Training effectiveness is determined in part by training design factors but, as Noe (1986) suggested, a variety of trainee characteristics such as ability, motivation, and attitudes can also contribute to training effectiveness and are potentially some of the most important determinants of training outcomes (Fleishman & Mumford, 1989). The following sections of this paper briefly summarize the literature on several trainee characteristics including ability, motivation, personality, and job attitudes.

Ability

Abilities refer to general capacities related to the performance of a set of tasks (Fleishman, 1972). A wide range of trainee abilities have been shown to be potentially important variables in explaining training effectiveness. For example, the research of Fleishman and others (see Fleishman and Mumford, 1989b) led to the development of a comprehensive set of 50 descriptor constructs for ability characteristics that influence task performance. This large set of cognitive, psychomotor, and physical ability categories (see the Manual

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

for the Ability Requirements Scales (MARS), Fleishman & Mumford, 1989a) has proven useful in evaluating ability requirements of tasks. However, the large number of potentially important task-related abilities that has been defined by this and other research has led to some debate about which abilities are most important, at which point in the skill acquisition process, and under what circumstances (Tannenbaum & Yukl, 1992).

One trainee ability that emerges as important across tasks and contexts is general cognitive ability. General cognitive ability is seen as a potent predictor of job performance and training success because it reflects the ability of individuals to employ the major cognitive processes (e.g., evaluation, planning, judgment, recognition, memory) that are used in day-to-day job performance. The lack of contextual or task specificity of cognitive ability measures (e.g., see Schmidt, Hunter, & Caplan, 1981) as well as relatively extensive empirical evidence support the view that general cognitive ability is an important factor in training effectiveness regardless of setting or job. A large number of studies and meta-analyses (e.g., see Hunter & Hunter, 1984; Hunter, 1986; Thorndike, 1986), for example, have demonstrated that general cognitive ability has high validity in predicting job performance ratings, objective measures of job performance, as well as success in training. In addition, a review of a number of trainability testing studies (Robertson & Downs, 1979) concluded that as much as 16% of the variance in trainee performance may be due to cognitive ability, suggesting that cognitive ability may account for a significant amount of the variance in training effectiveness (Noe & Schmitt,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1986). Based on these findings Hunter (1986) concluded that no other predictor of job performance or training success has the "pervasive predictive validity" of general cognitive ability. This variable, however, is often overlooked in studies evaluating training effectiveness, including transfer of training studies, making meaningful evaluation, particularly in situations in which trainee groups are heterogeneous with regard to cognitive ability, problematic (Holton, 1996).

Personality

The congruency interaction (Joyce, Slocum, & Glinow, 1982) posits that performance is maximized when there is a fit between the person and the situation. Similarly, Schneider's (1983) selection-attraction-attrition framework suggests that individuals select themselves into and out of organizations depending on how well they fit in with a particular organization. These perspectives recognize that, important as cognitive ability is as a component of successful job performance, there may be other significant factors that contribute to overall performance. For example, observing that most jobs are composed of varying degrees of both task and people requirements, Day and Silverman (1989) suggested that cognitive ability may not be as important for predicting performance in jobs which emphasize people requirements (e.g., ability to cooperate) as is personality.

This kind of reasoning has led to substantial research into the use of personality measures as performance predictors and as tools for employee selection. This research suggests, in general, that specific personality variables

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

can be significant predictors of job performance and are superior to general measures as valid predictors of job performance. For example, research has shown that specific personality variables can be significant predictors of job performance when matched with relevant job and organizational variables (Day & Silverman, 1989). A recent quantitative meta-analysis of 494 studies estimated the relationship between the "Big Five" personality dimensions (neuroticism, extroversion, openness to experience, agreeableness, and conscientiousness) and performance (Tett, Jackson, & Rothstein, 1991). Findings indicated that mean scale validity was .29 increasing to .38 with studies which used job analysis in the selection of personality measures. In short, research on the relationship between personality and job performance indicates that the use of general personality measures results in a loss of predictive power and argues strongly for the identification of specific personality trait-performance criterion linkages.

One personality trait that has received considerable research attention and has been linked with specific criterion measures is locus of control. Locus of control is a stable personality trait which describes "the extent to which people attribute cause or control of events to themselves (internal locus of control) or to environmental factors" such as luck or fate (external locus of control) (Kren, 1992, p. 990). Several studies have shown that locus of control is a personality trait which can influence a variety of specific behavioral outcomes. For example, research supports a moderating relationship between locus of control and academic achievement (Bar-Tal & Bar-Zohar, 1977), job

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

success (Andrisani & Nestel, 1976), performance (Spector, 1982), application of new knowledge gained in training (Baumgartel et al., 1984), goal attainment (Hollenbeck & Brief, 1987), "anti-output" behavior in the face of situational constraints (Storms & Spector, 1987), and motivation and effort (Kren, 1992). Locus of control may also interact with certain transfer design methodologies (e.g., relapse prevention) to encourage training transfer (Tziner et al., 1991).

Motivation

Trainees who enter training with higher levels of motivation have been shown to complete training at a higher rate, learn more, and perform at a higher level than trainees with lower levels of pre-training motivation (Baldwin et al., 1991; Mathieu et al., 1990; Tannenbaum et al., 1991). Ameel (1992), for instance, conducted an exploratory study into the effects of motivation to transfer on frequency of training use by sales personnel for a high-technology manufacturing firm. This research hypothesized a significant relationship between each of the following factors and frequency of training use:

1. Confidence in ability to use training on-the-job.

2. Expectation of intrinsic or extrinsic rewards resulting from the use of training.

3. Relevance of training content to job requirements.

4. Perceived supervisory support.

Ameel found each of these variables significantly and positively related to training use. A multiple regression analysis with these four predictor variables showed that together they accounted for 69% of the variance in training use.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Both confidence and relevance had significant beta values (β = .36 and .63 respectively, $p \leq .0001$) with supervisor support as the least influential variable. The author concluded that these results point to the importance of confidence, relevance, and rewards as key factors influencing trainees' motivation to transfer and support Vroom's (1964) valence-instrumentality-expectancy theory of training motivation.

Several authors (e.g., Baldwin & Ford, 1988; Noe, 1986) have recognized the value of studying training related motivation from an expectancy perspective. Tannenbaum et al. (1991) examined the training related expectations of naval recruits and found that trainees whose pretraining expectations were met reported greater posttraining commitment, self-efficacy, and motivation. Other research has shown that pre-training manipulations of supervisory expectations regarding trainee behavior can influence behavioral and attitudinal outcomes of trainees. Two studies (Eden & Ravid, 1982; Eden & Shani, 1982) studied the effect of leader expectancy on subordinate performance in a military training setting. Both of these studies used a pre-training manipulation aimed at inducing differential expectations among training instructors regarding incoming trainee performance. Results demonstrated a Pygmalion effect in which expectations of high performance resulted in increased performance. That is, trainees whose instructors expected more of them displayed more favorable attitudes toward training, perceived more positive leadership behavior, and received higher performance scores. These results show the persuasive influence of others' expectations and suggest that

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

supervisory expectancy training, in which supervisors are made aware of the power and are taught strategies to bring their expectations under rational control, could be used to improve subordinate performance (Eden & Shani, 1982). Eden and Ravid (1982) further suggested that increasing the expectancy of supervisors is not the only entry point for pre-training expectancy manipulations. Expectancy training could also be used to overcome the depressed self-expectancies of low performers and to break the cycle of "low superior expectations → low self expectations → low performance → low superior expectations" (p. 364).

Recent research points to a number of other factors with the potential to impact training outcomes through their influence on expectancies and trainee motivation. A study by Smith-Jentsch, Jentsch, Payne, and Salas (1996) examined whether training which trainees perceive can help them avoid negative events may foster a perceived need for training and "trigger enhanced readiness to learn for trainees who have previously experienced similar events" (p. 5). Results indicated that the number of negative training-related events that participants had experienced prior to training was predictive of their ability to apply trained skills one week after training. The authors suggested that trainees' pre-training experiences influenced posttraining performance by augmenting learning motivation.

Choice of training should also encourage transfer based on the rationale that the act of choosing encourages the perception that training offers some positive utility (Mathieu et al., 1992). Organizational behavior research into

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

participative decision making also supports the motivational role of choice by showing that increased effort as a consequence of behavioral commitment is a likely consequence under conditions of choice (Salancik, 1977). Results from a number of studies have confirmed that trainees allowed some degree of choice in training were generally more satisfied with training, showed higher motivation to learn, more positive reactions, and scored higher on achievement tests (Baldwin et al., 1991; Clark et al., 1993; Mathieu et al., 1992; Ryman & Biersner, 1975).

Several studies have pointed to the potential motivational value of providing trainees with advance information about upcoming training events (Baldwin & Magjuka, 1991; Hicks & Klimoski, 1987; Hoiberg & Berry, 1978; Quinones, 1995; Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). These studies strongly suggest that the provision of pre-training information can be a motivational force because it allows trainees to establish for themselves the relevance of training to their expected learning and performance needs and outcomes.

Taken together, this research suggests that a wide range of training-related factors have the potential to significantly impact overall training effectiveness through their influence on trainee expectancy and motivation. Moreover, many of the variables identified here are relatively open to manipulation (e.g., supervisor expectations, providing participants and their supervisors with information about upcoming training) and therefore offer the potential for dramatically enhancing training results with interventions that are

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

not overly difficult to accomplish (Baldwin & Magjuka, 1991) and which require comparatively little resource investment.

Self-Efficacy. Self-efficacy refers to an individual's belief in his or her ability to mobilize personal resources and courses of action to meet specific situational and task demands (Gist, 1987). This construct is seen as a potent intervening variable between training and performance (Gist, 1986) and its role in individual performance has been established by a number of studies. For example, a quasi-experimental study by Eden and Kinnar (1991) used peers in a modeling role to present persuasive information to large groups of military trainees in an effort to raise their specific self-efficacy regarding the trainees' qualifications to enter a special forces program. Results showed that boosting individuals' self-efficacy regarding a specific future behavior significantly increased the likelihood of their undertaking that behavior. The authors concluded that the "Galatea effect" demonstrated that interventions aimed at raising specific self-efficacy with regard to future performance can "motivate crucial productive behavior". Other studies (Frayne & Latham, 1987; Gist et al., 1989) have also suggested that pre-training interventions aimed at raising specific self-efficacy can be an effective performance improvement strategy.

Researchers have reported significant positive correlations between level of self-efficacy and task performance (Bandura, 1982; Locke, Frederick, Lee, & Bobko, 1984; Taylor, Locke, Lee, & Gist, 1984); training performance (Gist, 1986); posttraining transfer and job performance (Ford et al., 1992; Frayne & Latham, 1987; Latham & Frayne, 1989); and the likelihood an

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

individual will use new computer technology (Hill, Smith, & Mann, 1987). In addition, research has demonstrated a self-efficacy - performance relationship for both cognitive (Gist et al., 1991) and interpersonal skills (Gist et al., 1989). Finally, other studies have demonstrated that successful performance can enhance the development of self-efficacy (Bandura, 1982, 1991; Mathieu et al., 1993) suggesting the presence of a reinforcing feedback cycle between self-efficacy and performance: Initial self-efficacy enhances performance which, in turn, enhances subsequent self-efficacy.

In sum, research strongly suggests that self-efficacy can be an important predictor of success in training, a valuable process variable during training, and a desirable outcome of training (Tannenbaum & Yukl, 1992). A moderating relationship between self-efficacy and performance has been well documented in the literature, firmly establishing this variable as an important behavioral and motivational construct which can influence choices, goals, effort, persistence, and performance (Gist & Mitchell, 1992).

Job Attitudes

The relationship between job attitudes and transfer of training is one of the least explored areas in HRD (Baldwin & Ford, 1988; Holton, 1996). However, research from the field of organizational behavior has provided valuable insights suggesting the importance of job attitudes in training transfer.

Noe (1986) developed a model of motivational influences on training effectiveness that suggested trainee attitudes may attenuate or enhance the impact of training on learning, performance, and organizational results. There is

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

a good deal of research supporting this position. For example, Ryman and Biersner (1975) found that training confidence (i.e., expectations of success in training) was a significant predictor of training success as measured by graduation from a military training program. Noe and Schmitt (1986) found job involvement to be significantly related to learning in training. Employees with higher levels of organizational commitment have been found to perform better in training (Tannenbaum et al., 1991). Mowday, Porter, & Steers (1979) studied 37 bank branches and found performance level of work units was primarily differentiated on the basis of two job attitudes: Employees in high performing work units had higher levels of organizational commitment and job satisfaction than employees in low performing units. Given data such as these, it is reasonable to expect that job attitudes, just as they affect motivation to learn, learning, and performance would also influence transfer of training.

Job Involvement. Job involvement refers to the degree to which people identify psychologically with their work and the importance of work for their self-image (Lodahl & Kejner, 1965). Noe (1986) suggested that employees' motivation to improve work-related skills may be a function of their involvement in their job: Employees who are highly job involved are more motivated to participate and learn in training because such efforts can improve skill levels and enhance feelings of self-worth. The valence-instrumentality-expectancy perspective (Vroom, 1964) can be used to extend this reasoning to transfer of training behavior. That is, individuals who are highly job involved are likely to be more motivated to transfer learning to the job because such transfer would

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

increase job performance and lead to the accrual of desired outcomes (e.g., enhanced self-image or higher pay).

Noe (1986) also suggested that, because the self-image of high job involvement employees is tied directly to success or failure at work, cues in the work environment that are related to performance improvement may be more salient to these individuals. This implies, for example, that certain transfer climate cues, such as the goal, social, and task cues hypothesized by Rouiller and Goldstein (1993) to facilitate performance, may be more salient in explaining the performance of highly job involved individuals.

Only two studies have examined the relationship between job involvement and training outcomes. Noe and Schmitt (1986) found a significant positive relationship between job involvement and learning. Mathieu et al. (1992) attempted unsuccessfully to replicate this finding and suggested that this failure may have been a function of the type of training studied. Clearly, more research is needed to confirm the value and delineate the role of this attitudinal variable in training effectiveness.

Organizational Commitment. Organizational commitment has long been recognized as an important determinant to be included in modeling and researching employee behavior in organizations (Mowday, Porter, & Dubin, 1974). The construct has received increasing attention in recent years as a result of companies seeking ways to increase employee contributions to overall organizational effectiveness (Steers & Porter, 1991). Organizational commitment has been defined in a number of ways (e.g., see Mowday, Porter,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

& Steers, 1982). All definitions share the common theme that organizational commitment represents a bonding of the individual to the organization and most definitions reflect a distinction between commitment as an attitude or behavioral investment (Mathieu & Zajac, 1990). For example, calculative commitment refers to the bond between an individual and an organization resulting from side bets or sunk costs (e.g., a pension plan) that the individual has in the organization. Attitudinal commitment, on the other hand, focuses on the relative strength of an individual's identification and involvement in a particular organization. Meyer and Allen (1984) refer to the dichotomy between attitude versus behavioral investment as one between affective and continuance commitment. Regardless of terminology, attitudinal commitment is the definition most commonly used as an independent variable in research with job attitudes and the predictive validities of attitudinal appear to be higher than those for calculative commitment (Mathieu & Zajac, 1990). Three factors characterize the attitudinal conceptualization of organizational commitment: (a) A strong belief in and acceptance of organizational goals and values; (b) a willingness to exert considerable effort toward organizational goal accomplishment; (c) a strong desire to maintain organizational membership (Reichers, 1985).

Interest in organizational commitment has stemmed largely from its demonstrated negative relationship with turnover (Steele & Ovalle, 1984; Porter, Steers, Mowday, & Boulian, 1974). Research has also shown that the more committed an employee is to the organization, the more likely they are to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

have a long tenure with the organization (Koch & Steers, (1978), to expend greater effort in performing work related tasks (Steers, 1977), to engage in creative and innovative "extra role" behaviors (Katz & Kahn, 1978), and to exhibit improved job performance in some situations (Larson & Fukami, 1984). However, comparatively little research has been done examining the relationship between organizational commitment and job performance (Meyer, Pounonen, Gellatly, Goffin, & Jackson, 1989) and what has been done has largely failed to provide clear answers as to the nature of the relationship. For example, Meyer et al. (1989) examined the influence of affective and continuance commitment on three measures of job performance (composite performance, overall performance, and promotability) of employees in a food service organization. These researchers found affective commitment positively and continuance commitment negatively related to all three performance measures. The results of a meta-analysis of organizational commitment research (Mathieu & Zajac, 1990) identified only six of 124 published studies between 1974 and 1987 that addressed the relationship between organizational commitment and job performance. Based on their analysis of this research, these authors concluded that organizational commitment has "relatively little direct influence on performance in most instances" (p. 184).

Some authors have suggested that the nature of the linkage between the two types of commitment and the organization are quite different, a difference that has implications for the organizational commitment-performance relationship. Meyer et al. (1989), for example, suggested that employees high

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

in attitudinal commitment stay with an organization because they want to whereas those with strong calculative commitment stay with an organization because they feel the need to do so. The rationale is that those who intrinsically value organizational attachment may be more willing to exert considerable effort on the part of the organization than those who feel compelled to do so avoid financial loss (Mowday et al., 1982) or some other tangible cost. In other words, attitudinal commitment should be positively correlated with motivation to perform whereas calculative commitment may show little positive correlation with such a measure of motivation.

There is some evidence supporting this reasoning. Mowday et al. (1982) cited four studies which showed evidence of a moderate relationship between attitudinal commitment and motivation to perform with correlations ranging from .35 to .45. Mathieu and Zajac (1990) found overall job motivation correlated with organizational commitment ($r = .56$) across five studies examining this relationship. In addition, research aimed at identifying mediating/moderating variables between attitudinal commitment, motivation and performance conducted by DeCotiis and Summers (1987) found that attitudinal commitment had a direct positive influence on managerial employees' motivation and objective job performance.

In general, the research on organizational commitment demonstrates that when commitment reflects an attitudinal involvement in the organization, a payoff in the form of increased motivation performance may result. Thus, to the extent individuals' level of commitment predisposes them to view training as

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

personally useful and useful to the organization then organizational commitment can also be viewed as an important influence on training effectiveness (Mathieu et al., 1991). Although the role of organizational commitment in training transfer has received little if any research attention, the well established importance of this attitudinal variable as a determinant in employee turnover and work related motivation suggests that it may also play a significant role in the transfer of training. Since individuals in work settings are likely to experience varying degrees of commitment to the organization, work outcomes such as transfer of training may well be understood as at least partially a function of the motivational component associated with this commitment. Both theoretically and based on previous empirical findings it is reasonable to expect that organizational commitment may influence training transfer through its effect on motivation to learn in training and to transfer that learning once back on the job. Research is clearly needed to explicate the role and value of organizational commitment in this capacity.

Internal Work Motivation. Internal work motivation is an affective reaction an individual receives from doing a particular job and refers to the degree to which that individual is self-motivated to perform effectively on the job. Employees who are internally work motivated experience positive internal feelings when performing effectively on the job and negative feelings when performing poorly (Hackman & Oldham, 1976).

A limited number of studies have examined the role of internal work motivation in job performance. These studies have provided suggestive

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

evidence of a potentially useful relationship between internal work motivation and various dimensions of work performance. For instance, results of a study of 270 telephone company employees in 13 different jobs demonstrated internal work motivation was significantly and positively related to supervisory ratings of overall job effectiveness (Hackman and Lawler, 1971). No relationship was found, however, between ratings of either quantity or quality of job performance. Oldham (1976) studied 64 clerical workers and found substantial support for a positive correlation between levels of self-reported internal work motivation and supervisory ratings of work effort, work quality, and quantity of work.

Although these two studies suggest that internal work motivation may be a useful predictor of work performance, the role of internal work motivation as a variable affecting training outcomes does not appear to have been examined. If individuals with high levels of internal work motivation exhibit higher levels of job performance because by doing so they receive personally valued rewards, a logical extension of this reasoning would suggest that individuals with high levels of internal work motivation can also be expected to exhibit higher levels of both learning in training and increases in job performance subsequent to training than those with lower levels.

Summary

Research strongly suggests the characteristics trainees bring to the training situation have substantial relevance for understanding the training process. Taxonomies of trainee abilities have identified a wide range of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

cognitive, psychomotor and physical ability constructs which may influence task performance. General cognitive ability has been extensively studied and shown to be a reliable predictor of job and training performance. Specific personality traits such as locus of control have been shown to influence a range of behavior outcomes and to be better predictors of performance than more general personality measures. Substantial research has established self-efficacy as a valuable antecedent as well as consequence of job and task performance. A number of variables such as pre-training experiences, choice of training, and the provision of pre-training information have been shown to affect training outcomes through their influence on trainee expectancies and subsequent training related motivation. Organizational behavior research done with job attitudes suggests that these trainee characteristics may also play an influential role in determining training effectiveness. In short, the research reviewed here demonstrates that trainee characteristics are potentially important variables which can have both direct and indirect effects on training outcomes.

Despite the apparent importance of these variables in training effectiveness, research into trainee characteristics in organizational settings is still limited in many areas. Ilgen, Nebeker, and Pritchard (1981) reasoned that one of the most effective ways of influencing performance is to influence motivation. However, productive investigations into the role of motivation in training effectiveness require that the variable be operationalized more clearly with distinctions made between motivation to attend, motivation to learn, and

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

motivation to transfer (Tannenbaum & Yukl, 1992). Research done on training related expectancies has been productive and points to usefulness of this conceptual approach to motivation. The limited research done in this area suggests that the whole issue of training expectations needs to be more fully researched (Feldman, 1989). Investigations into the role of job attitudes is still quite limited and a number of other trainee characteristics such as openness to experience (Barrick & Mount, 1991) and trainee attributions of their own training performance (Campbell, 1988; Steiner, Dobbins, & Trahan, 1991) are also potential contributors to training effectiveness that have yet to be fully explored. Finally, research is needed addressing the relationships between these and other trainee characteristics and how the interactions of these variables affect training outcomes.

Work Environment Factors

Research examining the role of work environment factors in training transfer was virtually non-existent prior to 1980. Since that time limited research has suggested the presence of several potentially influential variables. Examination of the role of work environment variables was prompted by observations that highly motivated and competent trainees were often unable to use learned skills in the workplace because of variety of work environment supports and constraints (Kozlowski & Hults, 1987; Peters & O'Connor, 1980). In terms of training effectiveness, a major implication is that training is less likely to affect job behavior in the absence of a work environment supportive of training transfer.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Climate

One conceptualization of the manner in which work environment factors affect the transfer of learned behaviors to the job is through a transfer of training climate. Transfer of training climate refers, in general, to the type and degree to which factors in the workplace limit or augment an individual's application of KSAs learned in training to the job situation. The construct of transfer climate is seen as a moderating variable in the relationship between the organizational context and an individual's attitudes, motivation, and work behavior. Thus, even when learning occurs in training, the transfer climate may either support or inhibit the application of learned behaviors on the job (Mathieu et al., 1992).

Climate, as a general organizational construct, refers to a broad variety of organizational and perceptual variables reflective of organizational-individual interactions and which affect an individual's behavior in organizations (Glick, 1985). A good deal of organizational research has been devoted to climate and, although there is still some controversy over whether climate is an organizational, subunit, or individual level construct, most researchers agree that this construct can be a useful guide to research aimed at understanding organizational behavior (Jones & James, 1979; Rousseau, 1988; Schneider & Reichers, 1983). Glick (1985) suggested, for example, that since the relationship between individuals and organizations is inherently multidimensional, climate constructs "should be retained as useful categories of variables for multidimensional assessments of individual-organization"

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

interactions (p. 606). Furthermore, a number of researchers have defined specific criterion-referenced climate dimensions including leadership climate (Fleishman, 1955), climate for service (Schneider, 1980), climate for safety (Zohar, 1980), and work climate (Schneider & Hall, 1972) and found these constructs useful in understanding specific behavioral outcomes.

The importance of a supportive transfer climate has also received some empirical support. Baumgartel & Jeanpierre (1972) conducted an ex post facto examination of data collected from 17 management development training programs to determine which factors influenced the application of learned skills when Indian managers returned to their back-home job settings. Using self-reports as a criterion measure of adoptive efforts, the results of a correlational analysis showed six organizational variables with significant positive correlations:

1. Freedom to set personal performance goals (r = .27).

2. Degree higher management is considerate of feelings of lower management (r = .19).

3. Degree organization stimulates and approves of innovation and experimentation (r = .18).

4. Degree organization is anxious for executives to make use of knowledge gained in management courses (r = .18).

5. Degree of free and open communication (r = .16).

6. Willingness of top management to spend money for training (r = .15).

Analysis of variance results showed that differences in organizational climate

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

had a greater effect on adoptive efforts than differences in programs or personality differences between individual managers. The authors pointed out however, that, in addition to a skewed distribution of transfer scores (about half the sample had zero scores), the value of these findings is mitigated by the self-report measure of transfer (i.e., adoptive efforts) which had only "a very modest amount of validity" (p. 682).

Baumgartel, Sullivan, and Dunn (1978) attempted to replicate the above findings using a sample of US and British managers. In a survey of 811 participants from 28 companies these authors analyzed data from two sub-samples (n = 498 and n = 313). The findings from both sub-samples generally confirmed Baumgartel and Jeanpierre's (1972) conclusion: People in favorable organizational climates are more likely to apply new knowledge. The climate dimensions most closely associated with high adoption rates in this study were pressure for top performance, growth orientation, freedom to set personal goals, non-restrictive rules and procedures, and encouragement of risk-taking (see also Baumgartel et al., 1984).

Additional support for the importance of supportive organizational climates in transfer comes from a study by Tracy et al. (1995). These authors suggested that a culture which values knowledge and skill acquisition as an integral part of everyone's job may be an important construct in understanding the application of trained behavior. Testing this proposition with a sample of 505 supermarket managers involved in supervisory training, the authors found that a set of organizational values represented by a continuous-learning culture

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

construct, as well as a measure of more specific transfer climate elements (e.g., supervisor support), were directly related to posttraining performance.

In addition to these studies examining more general, composite climate measures, a number of specific climate dimensions and their impact on training outcomes have also been examined in the literature. Most importantly, these include social support factors such as supervisory and peer support of transfer, opportunity to perform trained tasks on-the-job, and various organizational characteristics such as the presence of transfer contingent rewards and punishments.

Supervisory Support. Supervisor support refers to the behaviors of supervisors which influence the extent to which subordinates can transfer training to the workplace (Holton, 1996). A number of authors have vigorously argued that supervisors play a major role in training transfer and that their supportive behavior can significantly influence the extent to which trainees can and do use training on-the-job (Beaudin, 1987; Broad, 1982; Broad & Newstrom, 1992; Garavaglia, 1993; Geroy & Penna, 1995; Noe, 1986; Noe & Schmitt, 1986; Phillips, 1991; Robinson & Robinson, 1989a; 1989b). Although this literature points to a number of supervisory actions believed to enhance trainee transfer behavior, very limited empirical work has been done to investigate them.

Research demonstrating that supervisory support may be a significant factor in the transfer process includes an exploratory study of learning transfer in management training (Huczynski and Lewis, 1980). These researchers

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

found that trainee attempts to transfer were more likely to be successful when they had discussed course content with their boss prior to the start of training. A follow-up four months after training indicated supervisory management style (e.g., extent to which supervisors were open to suggestions or new ideas) and involvement in reducing transfer inhibitors (e.g., employee work overload) were more important than peer or subordinate relationships. Clark et al. (1993) found that trainees' beliefs about how patient supervisors would be as they tried out new skills on the job was a significant predictor of perceived job utility of training which, in turn, predicted training motivation. These findings suggest that supervisor support leads trainees to expect that training has high job utility and therefore fosters higher training motivation.

Becker and Klimoski (1989) studied the relationship between organizational feedback environment and performance in a manufacturing firm. Using a revised version of the Job Feedback Survey (Herold & Parsons, 1985) and self, peer, and supervisory ratings of performance, these authors found that positive and negative feedback from supervisory and organizational sources accounted for most of the unique variance in performance as measured by the three performance ratings. Specifically, positive organizational/supervisory feedback was related to higher performance, negative feedback to lower performance, and feedback from organizational/supervisory sources was more highly related to performance than feedback from either self or peers. Finally, based on a hierarchical regression analysis of transfer variables, Xiao (1996) found that supervisory

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

support made a significant partial contribution to the explanation of the variance in self-reported transfer behavior.

Although these studies provide some evidence that supervisory support behaviors can positively influence performance, other studies have provided contradictory evidence. Gielen and VanderKlink (1995), for example, reviewed four field studies of transfer and supervisor support and concluded that there is little evidence supporting the importance of the supervisor as a transfer enhancing factor. Russell, Terborg, and Powers (1985) examined the impact of two organizational support variables, merchandising support and supervisory support, on organizational performance following store wide sales training in 62 retail stores. Supervisory support was not significantly correlated with either an objective (sales volume) or subjective (store image) performance measure in either a regression or partial correlation analysis.

Hastings (1994) conducted a study of state employment agency workers undergoing Job Service and unemployment interview training. This quasi-experimental study examined the role of supervisory support, supervisory involvement (as a trainer) in training, situational constraints, and self-efficacy on the speed and accuracy of Job Service registration and completion of unemployment claims interviews. Survey questionnaires were used to collect data on the independent variables and supervisor ratings were used for the dependent variables. Measures collected immediately following training and eight weeks later indicated that, contrary to expectations, supervisory support,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

supervisory involvement, situational constraints, and self-efficacy had no apparent effect on long term transfer.

This research leaves unanswered a number of questions about supervisory support and its role in training transfer. Although Baldwin and Ford (1988) have suggested that supervisory support is a multi dimensional construct, it is still unclear from current research how many critical dimensions of supervisory support there are, or which of these dimensions are most important in facilitating training transfer. Very few studies have assessed the factor structure of the supervisory support measures leaving unanswered questions about the content of this construct. For example, although supervisor support has been conceptualized as a composition of several behavioral dimensions or cues including modeling target behavior, provision of feedback, performance recognition, provision of reinforcement, and so on (see Rouiller & Goldstein, 1993), a recent study (Bates et al., 1996a) indicated the perception of supervisor support by trainees may be more unidimensional. This study showed that employees did <u>not</u> distinguish workplace support for the application of training with reference to a variety of specific behavioral cues. Rather, support was distinguished solely on the basis of the referent or source of that support (e.g., supervisors, peers, organization).

In addition, studies of supervisory support use different conceptualizations and measures of supervisory support behavior and are predominantly correlational in nature. The conceptual variation of supervisory support from study to study limits our ability to make generalizations about the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

construct. A reliance on correlational research limits our ability to fully explicate the relationship between supervisor support and training outcomes. Finally, research has failed to identify which factors mold an individual's perception of supervisor support. For example, it is not clear whether a specific event (e.g., positive feedback) or the interpersonal context (see Deci, Connell, & Ryan, 1989) is of particular functional significance in influencing trainee perceptions of support.

Although the proposition that supervisory support plays a strong role in training transfer has a great deal of intuitive appeal, the current research offers, at best, only mixed results about its value and role in training transfer and gives little indication of what supervisory behaviors are most important in supporting transfer. Systematic research is needed which (a) examines the specific mechanisms by which various kinds of social support (supervisor, peer, subordinate) lead to transfer (Ford et al., 1992); (b) identifies and defines critical construct dimensions; (c) develops reliable, valid, and generalizable measures of these constructs, and tests their influence in different settings.

Situational Constraints and Opportunity to Perform. Opportunity to perform refers to the extent to which trainees "are provided with or obtain work experiences relevant to the tasks for which they were trained" (Ford et al., 1992, p. 512). A number of authors have suggested that a variety of situational factors in the work environment can interfere with an individual's capacity to convert learning, ability, and motivation into effective performance (Campbell, 1988; Noe, 1986; Peters et al., 1985). For example, a taxonomy of at least

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

eight general situational constraints (job-related information, tools and equipment, materials and supplies, budgetary support, required services and assistance from others, task preparation, time availability, and work environment factors such as appropriate lighting) has been proposed by Peters and O'Connor (1980). This list was expanded with the identification of 22 specific supervisory constraints (O'Connor et al., 1984) and 14 non-supervisory categories (Peters, O'Connor, Eulberg, & Watson, 1988).

Situational constraints have been cited by several authors (Baldwin & Ford, 1988; Goldstein, 1986; Wexley & Latham, 1991) as potentially important variables in the transfer of trained skills. The expectation is that in work environments with high levels of situational performance constraints, low levels of performance or training transfer will result. These effects may be either direct (e.g., through lack of appropriate tools) or indirect (e.g., through effects on individual motivation) (Peters, Fisher, & O'Connor, 1982). Expectancy theory (Vroom, 1964), for instance, predicts that inhibiting situational conditions would affect motivation by lowering individuals' expectancy beliefs with regard to both the effort-performance and performance-outcome relationships. Phillips and Freedman (1984) provided some preliminary support for this reasoning in their finding of a negative relationship between individuals' perceptions of workplace situational constraints and work motivation.

Research has provided evidence suggesting that several inhibiting and facilitating situational factors can influence job performance. Laboratory investigations (Peters, O'Connor, & Rudolf, 1980; Peters, Chassie, Lindholm,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

O'Connor, & Rudolph, 1981) showed that inadequate job-related information, tools and equipment, materials and supplies, and task preparation resulted in lower task performance and negative affective reactions. Correlational field studies have also provided evidence of influential situational variables. Huczynski and Lewis's (1980) work manifested several factors (overload of work, crisis work, and high rate of change) which were perceived by trainees as preventing utilization of learned skills. O'Connor, Peters, Pooyan, Weekly, Frank, and Erenkrantz (1984) developed a 22 item single scale measure of perceived situational constraints to study the relationship of this measure with the performance, affective outcomes, and turnover of managers in a national convenience store organization. Results showed that inhibiting situational constraints were significantly associated with lower appraised performance, lower job satisfaction, higher frustration and turnover. Mathieu et al. (1992) developed and tested a model of individual and situational influences on training motivation and training effectiveness. Using LISREL analysis, the results showed a measure of situational constraints (based on Peters et al., 1985) had a marginally significant ($p \leq .10$) negative influence on trainee motivation. Mathieu et al. (1993) collected survey data from a sample of university students enrolled in an eight week bowling class in an effort to examine the influence of individual and aggregate level situational constraints on self-efficacy. These authors found a negative significant path ($p \leq .05$) from individual level constraints (e.g., competing demands for time) to a mid-

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

course self-efficacy measure. Thus, trainees who felt more constraints were less likely to believe they could master the skills in training.

In terms of transfer, one possible interpretation of these findings is that situational constraints directly (through lack of proper equipment) or indirectly (through lowered expectancies or self-efficacy) limit the number of relevant work experiences or opportunities to perform that trainees are able to obtain, thereby reducing training transfer. Two studies have directly addressed the role of opportunity to perform in transfer. Ford et al. (1992) demonstrated that trainees have differential opportunity to perform trained tasks and that work context and individual characteristics were related to these differences. They examined the effects of supervisory attitudes toward trainees, supportiveness of the work environment, and trainee characteristics (self-efficacy, ability) on opportunity to perform trained skills resulting from basic training for Air Force ground equipment specialists. Three task dimensions were identified as relevant in assessing opportunity to perform. These included breadth (number of tasks performed), activity level (number times a task was performed), and type of task (comparative difficulty and complexity of tasks). Results, based on self-report data, indicated that both work context factors and individual characteristics were related to opportunity to perform. In terms of work context, (a) positive supervisor perceptions of the trainees' capability, skill, and likability was a significant predictor of number of task performed; and (b) positive supervisor perceptions and the presence of a supportive work group were significantly associated with subjects reporting they performed more complex

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

and difficult tasks. An individual characteristic (high self-efficacy) was similarly associated with breadth and type of activity.

Findings of another study (Gielen, 1995) supported the Ford et al. (1992) results. In this study, trainee self-efficacy and supervisor support accounted for 23% of the variance in opportunity to perform (defined as trainee perceptions of actual workplace performance possibilities) suggesting that trainees high in self-efficacy or who received more supervisory support were more likely to have an opportunity to perform learned tasks on the job. Opportunity to perform was also a significant predictor of self-efficacy. This finding of a reciprocal relationship between opportunity to perform and self-efficacy led Gielen to suggest that opportunity to perform may moderate performance rather than intention to perform. Opportunity to perform was also found to be positively correlated with post-training performance ($r = .25$), although this relationship was not strong enough to emerge in a regression analysis.

These findings support the contention that there are systematic differences in individuals opportunity to perform trained tasks on the job. In addition, the research complements and extends transfer research by providing preliminary evidence that work context can impact transfer and training effectiveness through its potential to inhibit or facilitate an individual's opportunity to perform trained tasks on the job (Ford et al., 1992).

In general, however, the training research literature has virtually ignored the role of opportunity to perform as an influential variable in training transfer. Most studies evaluating training effectiveness have made the untested

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

assumption that trainees have relatively similar opportunities to practice and perform learned tasks on the job (Ford et al., 1992). Although the idea that practicing and using skills immediately upon the return to the job can have a major impact on skill retention and transfer makes a great deal of intuitive sense, more research is needed to further specify the opportunity to perform construct and to link dimensions of this variable with inhibiting/facilitating factors in the work environment, with indicators of training transfer, and training outcomes.

Integrated Models of the Transfer Process

A number of studies (e.g., Huczynski & Lewis, 1980; Rouiller & Goldstein, 1993; Tracy et al., 1995; Xiao, 1996) have produced findings indicating that transfer climate can significantly affect an individual's ability and motivation to transfer learning to job performance. These studies have generally viewed transfer as an complex process and have undertaken the task of developing integrated models of training transfer. Inherent in these models is the explicit recognition that one dimensional views of transfer, such as those focusing on instructional design alone or supervisor support, are not comprehensive enough to substantially increase our understanding of the training transfer process. Integrated transfer models illustrate the necessity for a framework capable of considering the wide range of factors including training design variables, trainee characteristics, and work environment factors which have the potential to affect the transfer process.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

One of the first integrated approaches to transfer was presented by Huczynski & Lewis (1980). These researchers conducted a study with participants in two management training courses aimed at identifying the factors which differentiated participants who attempted to transfer learning to the job and those who did not. Their findings indicated:

1. Three pre-course conditions separated individuals who attempted transfer from those who did not. Among those participants who attempted transfer, more attended the course on their own initiative, believed the course would help them in their jobs, and discussed the content of the course with their supervisor prior to the start of the course.

2. Organizational factors including work overload, crisis work, difficulty convincing other workers of the value of transferring learning, and high rates of change inhibited transfer attempts following completion of the course.

3. Key transfer facilitators focused on supervisory attitudes and management style: Trainees who had supervisors who were open to new ideas and willing to allow experimentation with them were more likely to make transfer attempts.

Based on these findings the authors developed a model of transfer that focused on the interaction of training course variables, trainee motivation, and work environment (see Figure 2). Their model indicated that trainees' motivation to transfer is enhanced if the to decision to attend training is a result of their own initiative, if they perceive that course content will improve job performance, and if trainees are able to discuss the content and potential

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

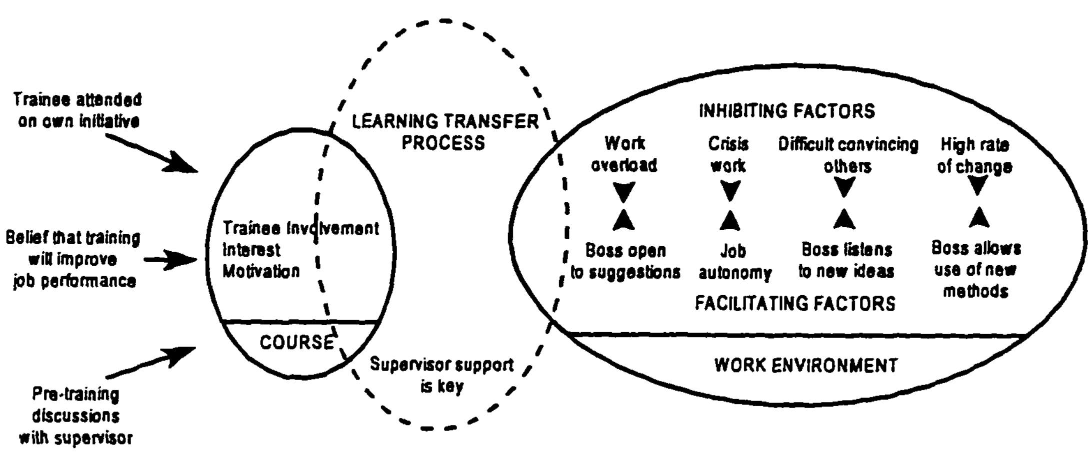


Figure 2: Huczynski & Lewis (1980) Transfer Process Model

value of training with a superior prior to training. The work environment is seen as providing factors that both inhibit and facilitate transfer, the influence of which extends from before the training course begins until after it ends. Of crucial importance is the key role supervisors play in facilitating the transfer process through their willingness to listen to new ideas and support employee experimentation with them. The underlying theme of this model is the presence of a pervading influence of the management style and attitudes of trainees' supervisor in all phases of the learning and transfer process.

The Huczynski and Lewis (1980) study and resulting model provided insights into and suggested the importance of environmental factors in training transfer. The study's conclusions, however, should be interpreted cautiously. The data were based on a relatively small sample (n = 48) of Scottish subjects suggesting generalizability limitations. Subjects also attended training

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

programs conducted by different organizations (a University-run course versus a course run by a management consultancy firm) indicating that intra session differences could have affected outcomes in unknown ways. Finally, group comparisons were made on the basis of self-reported intention to transfer, a criterion measure of questionable validity.

Noe (1986) integrated organizational behavior theory and research into an exploratory model of motivational influences on training effectiveness which directly addressed a number of variables affecting training transfer. The model, developed within the general valence-instrumentality-expectancy theory framework, described the possible influence of trainee job and career attitudes, personality traits, expectancies, reaction to skill assessment feedback, and environmental favorableness on multiple measures of training effectiveness (learning, behavior change, and results). The model (see figure 3)

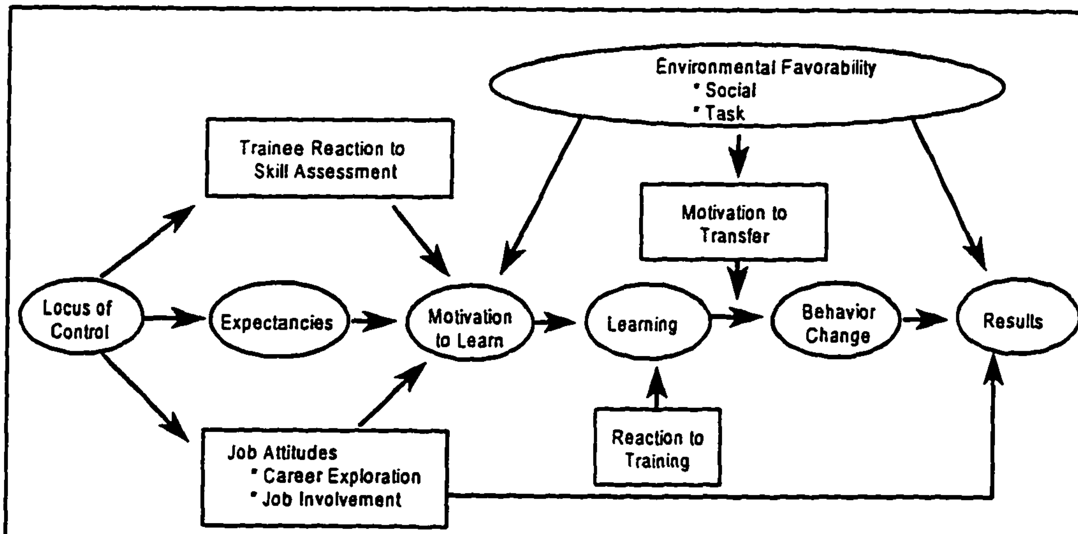


Figure 3: Motivational Influences on Training Effectiveness (from Noe & Schmitt, 1986)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

hypothesized that reaction to skill assessment feedback, trainee expectancies, and career/job attitudes have a direct impact on trainees' motivation to learn. Environmental favorableness, consisting of a task component (e.g., appropriate tools, equipment, monetary support) and a social component (e.g., opportunity to practice, perceptions of supervisory and peer support), directly influences motivation to learn, the transfer of skills from the training to work context, and the results criteria (e.g., job performance). Motivation to transfer training moderates the relationship between learning and behavior change with maximum behavior change occurring when trainees' master program content and are highly motivated to transfer learning to the job.

Noe and Schmitt (1986) tested the proposed model with a sample of 44 educators who participated in a training program aimed at improving administrative and interpersonal skills. Using a path analytic approach, this study examined the impact of locus of control, reaction to skill assessment, job involvement, career planning, exploratory behavior, pre-training motivation, and posttraining motivation on trainee satisfaction with training content and administration (i.e., reaction to training), and gain scores calculated for learning, behavior change and job performance. Results showed the only statistically significant relationship in the proposed model was between behavior change and performance improvement, most of the other path coefficients were small and nonsignificant.

Statistically, the hypothesized model could not be rejected at the .05 level. Nevertheless, the researchers found the model unacceptable because of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

a lack of support for proposed path linkages and a large residual correlation matrix. An alternative path model (see figure 4) was therefore developed which represented "the best effort to match the data to a conceptually meaningful framework" (Noe & Schmitt, 1986, p. 514). Although the small sample size used restricted the statistical power of this study, several important relationships are suggested by the revised exploratory model:

1. A statistically significant path ($\beta = .51$) between reaction to skill assessment and reaction to training suggested that trainees who agreed with the assessment of their skill needs had a more positive reaction to training (i.e., perceived the content of training to be more useful).

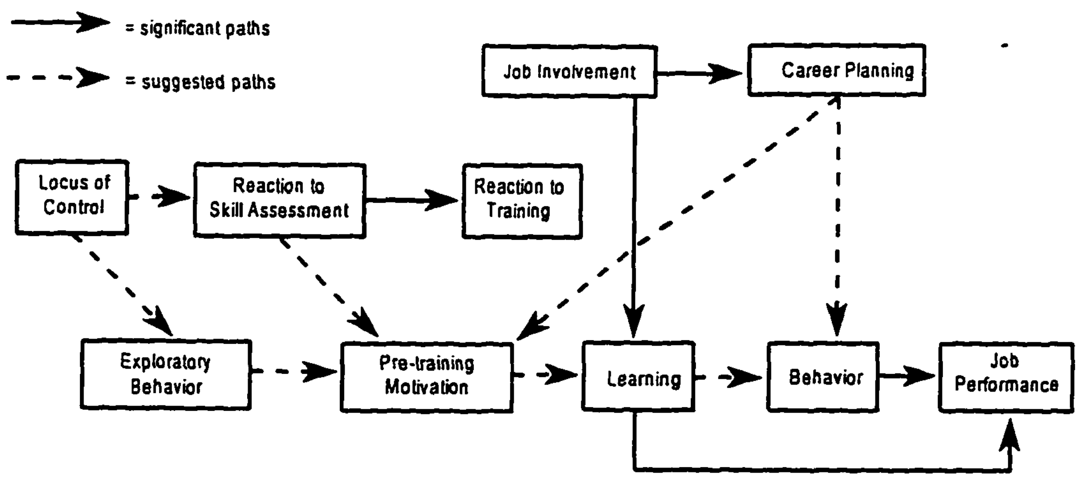


Figure 4: Alternative Path Model (from Noe & Schmitt, 1986)

2. The hypothesized linear relationship between learning, behavior, and performance (see Kirkpatrick, 1987; 1994) received only partial support. As predicted, behavior change was significantly related to performance

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

improvement (β = .50). Learning, however, showed virtually no relationship with behavior change yet was significantly related to improved job performance (β = .61). Noe and Schmitt (1986) suggested these findings support the collection of multiple types of outcome data when evaluating training effectiveness as each may provide unique information about specific training outcomes.

3. Trainees' involvement in their jobs and careers appeared as important antecedent variables in training effectiveness. Job involvement showed a significant, positive relationship with learning (β = .45) and, although not significant, the data showed that trainees' who engaged in career planning activities demonstrated greater pre- to posttraining behavior change (β = .25). As might be expected, job involvement was positively and significantly correlated with career planning.

4. Noe and Schmitt (1986) noted that the absence of motivation to transfer and work environment favorableness in the alternative model were due to construct validity problems, suggesting the need for further work developing adequate measures of these potentially important yet inadequately tested constructs.

Mathieu et al. (1992) developed and tested a model, based on valence-instrumentality-expectancy theory, which linked individual and situational variables to trainees' training motivation and training motivation to several training outcome measures. Outcome measures included trainee reactions to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

training, training motivation, learning, and posttest performance. Following Noe (1986) and Noe and Schmitt (1986), the proposed model (see figure 5) hypothesized two individual variables as antecedents of training motivation, career planning and job involvement. Two situational variables were also

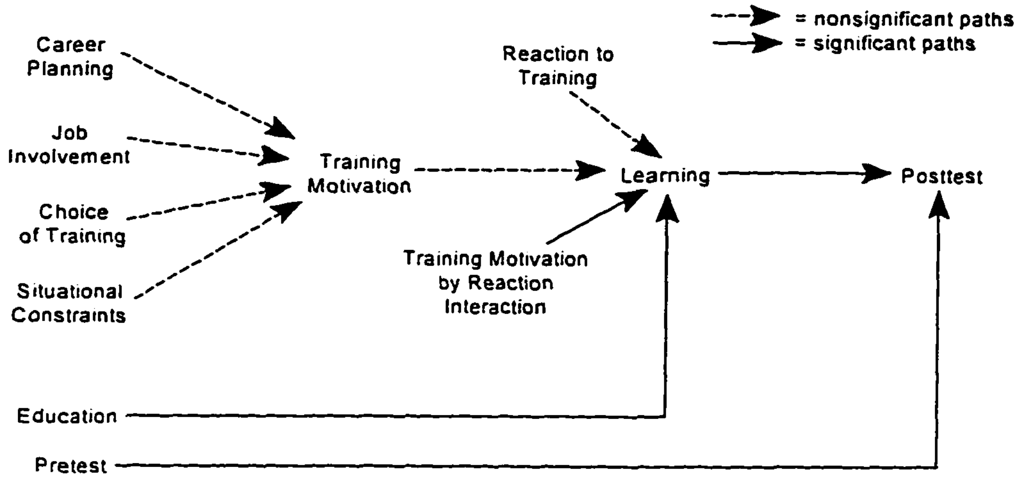


Figure 5: Results of the Hypothesized Model (from Mathieu et al., 1992

hypothesized as motivational antecedents. First, recalling the findings of several studies into the role of choice in training motivation (e.g., see Baldwin et al., 1991; Hicks & Klimoski, 1987), it was suggested that trainees who chose, through self-nomination, to attend the training program would perceive greater instrumentality and therefore would display greater training motivation than trainees otherwise assigned. Second, the model hypothesized a negative path from perceived work environment situational constraints to training motivation. Theoretically, situational constraints reduce the perceived instrumentality of training and, consequently, training motivation. The model predicted that

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

training motivation will relate positively to learning and, further, that trainees' reactions to the training program moderate the relationship between motivation and learning. That is, an ordinal interaction is proposed such that individuals who react positively to training will exhibit higher levels of motivation than those who do not have positive reactions. Although tested, the researchers did not anticipate a linear relationship between reactions and learning. Learning was expected to be positively related to posttest performance. Finally, education level was hypothesized to be positively related to learning and pretest scores to be positively related to posttest performance.

Based on data from 106 university employees attending a training program designed to improve proofreading skills, the model was tested using structural equation modeling (LISREL VII). Results showed that, although the direct influence of learning and pretest scores on posttest performance and education were significant and in the hypothesized direction, the data in general failed to support the hypothesized relationships. An exploratory revised model (see figure 6) was developed in an attempt to better explain the findings. This model:

1. Dropped the paths from career planning and job involvement to training motivation. In contrast to the findings of Noe & Schmitt (1986), this study does not provide evidence suggesting the value of these variables as antecedents to training motivation.

2. Dropped the path from choice to training motivation. The results did not show that giving trainees a choice in training would directly increase training

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

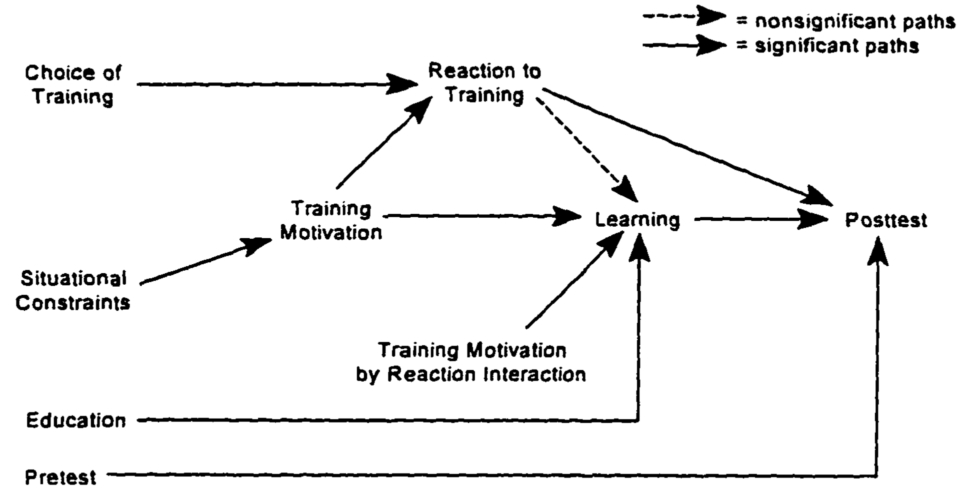


Figure 6: Revised Model (from Mathieu et al., 1992)

motivation. Rather, the data showed that reaction to training mediated the influence of choice on learning and posttest performance.

3. Added a significant ($p \leq .05$) positive path from choice to reaction to training.

4. Added a significant ($p \leq .05$) direct path from reaction to training to posttest performance.

5. Added a significant ($p \leq .05$) path from training motivation to training reactions showing that both choice and training motivation led to positive reactions to training.

6. Confirmed a marginally significant ($p \leq .10$) negative path from situational constraints to training motivation.

This research is consistent with the findings of Noe and Schmitt (1986) in showing that reactions to training (a) are not primary training outcomes and (b) reactions can play a complex, multifaceted role in training effectiveness

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

mediating some relationships between intervening variables and outcomes and moderating others. This is a far different role for this variable than the linear relationship with learning that reactions are portrayed as having in the four level evaluation model (Kirkpatrick, 1987; 1994), the dominant training evaluation model in current use. More importantly, this study contributes evidence supporting the influence of choice, situational constraints, training motivation, and reactions to training on training outcomes. These findings, as well as those of Noe and Schmitt (1986), suggest the existence of complex interrelationships among a number of variables which affect learning, behavior change, and performance results.

Rouiller and Goldstein (1993) (see also Rouiller, 1989) conducted a study examining the impact of transfer climate on posttraining performance. Transfer climate was defined as "those situations and consequences which either inhibit or help to facilitate the transfer of what has been learned in training into the job situation" (p. 379). This study offered a conceptual framework based on Luthans and Kreitner's (1985) organizational behavior modification model for operationalizing the transfer climate construct. The framework consisted of two general types of workplace cues comprising eight distinct dimensions of transfer climate (see Table 2).

The first set of workplace cues, situational cues, serve to remind or provide the opportunity for trainees to use what they have learned on the job. Situational cues were proposed to have four dimensions: (a) goal cues (b) social cues (c) task cues and (d) self-control cues. The second set of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 2: Transfer Climate Constructs (Rouiller & Goldstein, 1993)

Situational cues: Cues that serve to remind trainees of their training or provide them with an opportunity to use their training on the job.
Goal cues serve to remind trainees to use their training when they return to their jobs; for example, existing managers set goals for new managers that encourage them to apply their training on the job.
Social cues arise from group membership and include the behavior and influence processes exhibited by supervisors, peers and/or subordinates; for example, new managers who use their training supervise differently from the existing managers.
Task cues refer to the design and nature of the job itself; for example, equipment is available in this unit that allows new managers to use the skills they gained in training.
Self-control cues concern various self-control processes that permit trainees to use what has been learned; for example, "I was allowed to practice handling real and job-relevant problems."
Consequences: As employees return to their jobs and begin applying their learned behavior, they encounter consequences that will affect their further use of what they have learned. A number of different types of consequences exist.
Positive feedback. In this instance, the trainees are given positive information about their use of the trained behavior; for example, new managers who successfully use their training will receive a salary increase.
Negative feedback. Here, trainees are informed of the negative consequences of not using their learned behavior; for example, area managers are made aware of new managers who are not following operating procedures.
Punishment. Trainees are punished for using trained behaviors; for example, more experienced workers ridicule the use of techniques learned in training.
No feedback. No information is given to the trainees about the use or importance of the learned behavior; for example, existing managers are too busy to note whether trainees use learned behavior.

workplace cues, consequence cues, refer to on-the-job outcomes which affect the extent to which training is transferred. Consequence cues were also presumed to have four dimensions: (a) positive feedback (b) negative feedback (c) punishment and (d) no feedback.

The proposed transfer model was tested in a study of 102 fast food restaurant management trainees assigned to 102 physically separate business units. Results demonstrated that aggregated unit level perceptions of transfer climate added significantly to the explained variance in transfer behavior after controlling for learning and unit performance. Although consequences as a

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

component of transfer climate were hypothesized to be more influential than situational cues in their effect on transfer, both variables were found to add significantly to the explained variance in transfer behavior over and above the other. In a hierarchical multiple regression analysis, learning accounted for 8% of the variance in transfer behavior, but learning and transfer climate together accounted for 54% of the variance. Examination of the relationship between learning, transfer behavior, and job performance revealed that learning was not directly related to job performance. Rather, learning was linked to job performance through its relationship with transfer behavior. The significant paths of the transfer model are shown in figure 7.

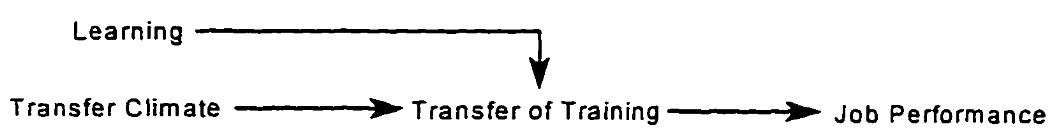


Figure 7: Hypothesized Model of Transfer (from Rouiller, 1989)

The results of this study are valuable in at least two ways. First, the regression results demonstrated strong support for a predictive relationship between transfer climate and learning on transfer behavior. Second, the establishment of the transfer climate-training transfer relationship provided a new perspective into the potential influence of the work environment on training outcomes. Although the content validity of the transfer climate measures used in this study were well established by Rouiller and Goldstein (1993), the construct validity of the measures has not been validated. The authors

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

proposed eight specific dimensions of transfer climate which combine to make two general dimensions (situational cues and consequence cues) yet only the general dimensions were significant, leaving open the question of which specific dimensions were most influential (Holton et al., 1996a). The separate climate scales were also highly intercorrelated indicating some overlap in what the scales were measuring. New research is therefore needed which (a) involves a factor analysis of climate items aimed at identifying underlying constructs, and (b) examines the influence of specific climate dimensions on transfer behavior in an effort to provide insight into their relative importance.

Tracy et al. (1995) attempted to replicate and extend the work of Rouiller and Goldstein (1993) using items drawn from their instrument along with an additional variable presumed to affect transfer, continuous learning culture (see also Tracy, 1992). Noting that Rouiller and Goldstein (1993) had used a focused conceptualization of transfer climate (i.e., one based on shared, meaningful perceptions of specific and salient organizational elements), Tracy et al. suggested that a more general interpretation may also be important, one reflecting more global beliefs about organizational values. Research has shown, for example, that employees form global beliefs about organizational support and that these beliefs can affect effort toward meeting organizational goals (see Eisenberger, Huntington, Hutchison, & Sowa, 1986). Continuous learning culture was therefore proposed by Tracy (1992) as a construct representing employee beliefs about general organizational values reflecting the importance of ongoing knowledge acquisition and application. This kind of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

learning oriented culture is prevalent in many models of organizational change (e.g., TQM) and is presumed to have a broad influence on individual and organizational effectiveness.

In order to test the effect of this construct on transfer behavior, Tracy (1992) operationalized the construct with questionnaire items measuring perceptions, beliefs, expectations, and values reflective of a broad range of individual, task, and organizational factors supporting learning and its job application (e.g., "In your store, independent and innovative thinking is encouraged by supervisors"). Structural path analysis used to test a measurement model revealed a direct relationship between both transfer climate and continuous learning culture with posttraining behavior. Examination of transfer climate and continuous learning culture as moderators of learning and posttraining behaviors failed to improve the model.

The significant relationships in the Tracy et al. (1995) measurement model are shown in figure 8. These findings demonstrated that both training specific environmental cues as well as other salient workplace cues more broadly related to learning (i.e., continuous learning culture) can have a direct effect on transfer behavior. In addition, a detailed level of aggregation analysis indicated that individuals who commonly interact with each other in the workplace are most likely to share climate and culture perceptions. This finding supports the notion forwarded by others (e.g., Baldwin & Magjuka, 1991) that interventions aimed at establishing a supportive learning and transfer

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

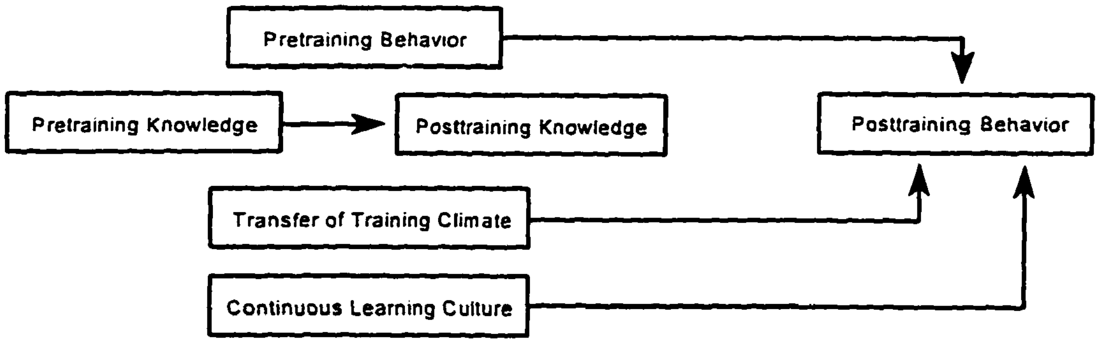


Figure 8: Transfer Process Measurement Model (from Tracy et al., 1995)

environment are best directed at the level of the trainees' work group (i.e., supervisors and co-workers).

In contrast to Rouiller & Goldstein's (1993; Rouiller, 1989) results, Tracy (1992) found no significant relationship between learning in training and transfer behaviors. This result is counter-intuitive and particularly surprising in light of the finding in a review of 12 training evaluation studies (Alliger & Janak, 1989) which showed a direct relationship between learning and job behavior. However, as Tracy (1992) pointed out, the relationship between learning from training and job behavior may be moderated by several factors not included in this study including pre-training motivation (Baldwin & Magjuka, 1991), situational constraints (Peters et al., 1983), or any number of other factors (e.g., see Broad & Newstrom, 1992; Robinson & Robinson, 1985). Thus, although it is true that for transfer of new behaviors to occur learning must first take place, the findings of this study suggest two important points: (a) The mastery of task specific content is a necessary but not sufficient condition to ensure transfer and changes in job behavior; (b) to fully understand the learning-transfer

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

relationship a broad, systems view of performance is required, one which includes a range of potentially influential variables.

Gielen (1995) observed that because research modeling the transfer process "has tended to focus on only a few influencing factors at a time" the evidence about the effects of these factors is fragmentary. She proposed and tested a relatively more comprehensive model and examined the interrelationships among learning, opportunity to perform, self-efficacy, job involvement, perceived training relevance, performance and several other variables. In analyzing the data in this study, however, Gielen (1995) used a series of stepwise regression analyses as if taking a path analytic approach to model testing. This approach, coupled with the multicolinearity of the independent variables used in these analyses, suggests some potential problems. First, weaknesses of the stepwise approach (e.g., consideration of only one variable at a time and the increase in overall error rate due to multiple significance tests) suggest limitations to the findings. The most serious problem, however, with the analytic technique employed in this study is that the absence of significant results of the regression analyses were used to delete variables from the tested models. The presumption in this approach is that acceptance of the null hypothesis indicates that the variables are unimportant and therefore should be deleted. However, failure to reject the null hypothesis provides evidence only of no significant finding and not positive evidence that a variable should be deleted from a model. Nevertheless, although the unique

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

analytical approach used in this study raises some important validity questions, the findings are useful insofar as they do suggest further research questions.

The results of the Gielen (1995) study only partially confirmed the proposed model. Findings revealed, first, that work experience and formal education negatively affected learning. This unexpected finding was apparently due to a ceiling effect in which more experienced and educated workers scored higher on pretests and were thus more likely to score lower on posttest. Second, according to Gielen, the most important variable to emerge in this study was self-efficacy. This variable was found to have a mutually supporting relationship with opportunity to perform trained task on the job and to be positively correlated with performance. Based on these relationships, Gielen reasoned that opportunity to perform was the performance moderator (through self-efficacy effects) rather than motivation to perform. Supervisory support was the only significant predictor of performance in addition to being correlated with perceived training relevance and opportunity to perform. In fact, supervisory support was found to have a profound impact on trainee behavior throughout training. No direct link between learning in training and performance was found although learning was a predictor of job involvement which was positively correlated with performance. Opportunity to perform, job involvement and self-efficacy were all positively correlated with performance but none were robust enough to emerge in regression analyses. The significant relationships in Gielen's (1995) model are summarized in figure 9.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

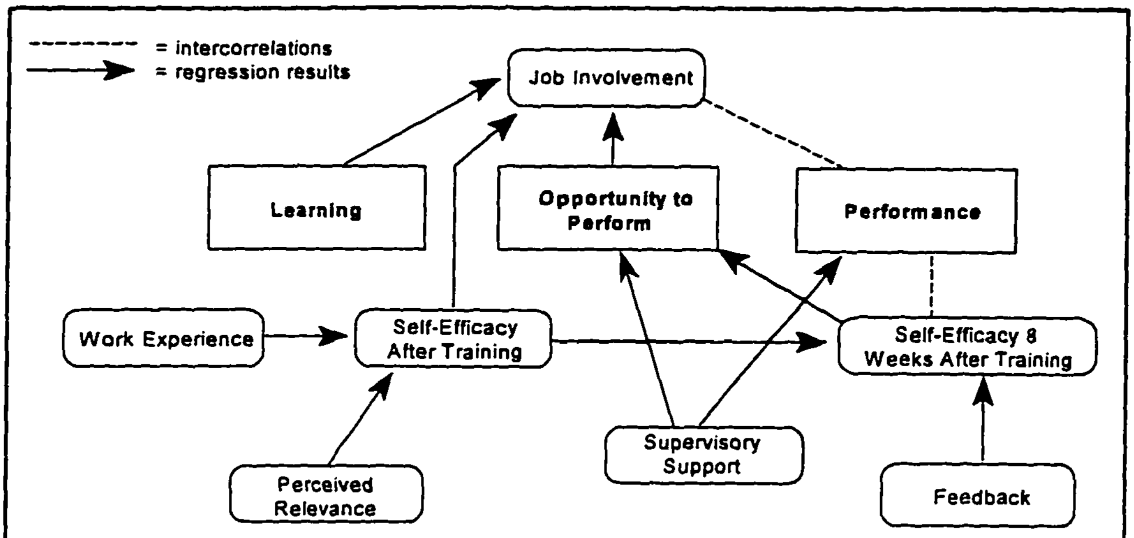


Figure 9: Transfer of Training Relationships (from Gielen, 1995)

Xiao (1996) proposed a model of transfer used to study training in the electronics industry in China. This model viewed training as a tool which develops trainee potential for performance. A number of factors were hypothesized to affect the extent to which potential is demonstrated in job performance including learning from training; worker characteristics (work experience, skill level, education attainment, age); the extent to which work is designed to match workers' knowledge, skill, and ability level; and work environment factors including application orientation (extent to which the trainee is informed a priori of the training event, believes the content is relevant to job tasks, and is required to use new KSAs), the linkage of timely rewards with good performance, supervisory support, and supportive peer relationships (see figure 10).

In this study, transfer was measured by questionnaire items assessing transfer behavior as well as an objective measure (group scrap rates) of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

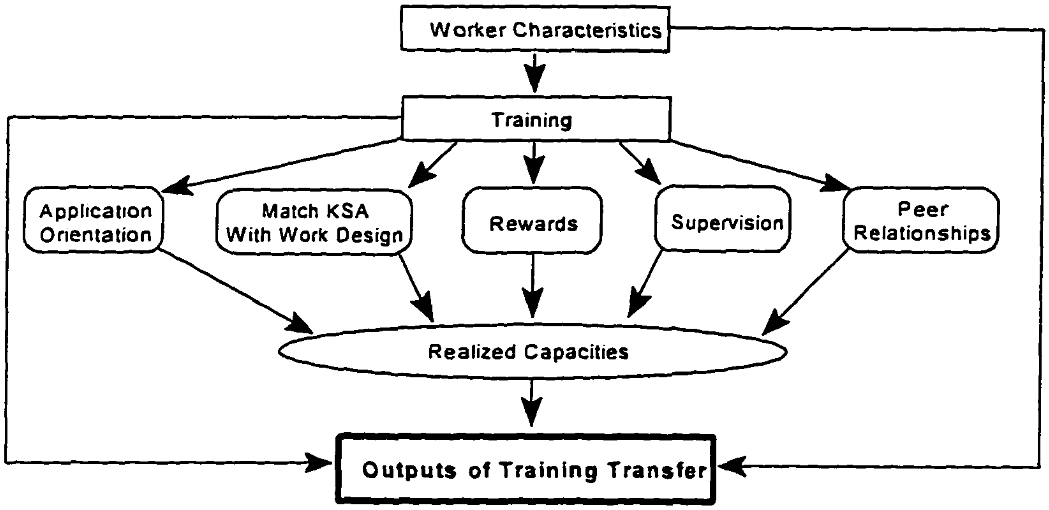


Figure 10: Determinants of Training Transfer (from Xiao, 1996)

employee skill proficiency. The results of a hierarchical regression analysis revealed that (a) learning in training as perceived by trainees explained a significant proportion (14%) of the variance of self-reported transfer behavior; and (b) organizational factors accounted for a significant proportion (29%) of the variance in transfer behavior over and above training. Of the five organizational factors examined, matching worker KSAs with job design and supervisory support were the most influential in explaining the variance in transfer. Worker characteristics (age, education, skill level, and work experience), application orientation, rewards, and peer support explained little of the variance in transfer behavior. Data on group scrap rates confirmed that learning in training was significantly related to performance. Four of the five variables examined in this study can be considered transfer climate variables. Of those four (application orientation, supervisory support, rewards, and peer relationships) only supervisory support was significantly related to transfer

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

behavior. Xiao concluded that supervisory support was the climate variable with the greatest impact on transfer behavior, a conclusion which echoed the findings of Huczynski and Lewis (1980).

Two key methodological issues suggest limitations on the validity of Xiao's findings. One issue is the use of self-reports as measures of the major dependent variable, transfer behavior. Self-ratings of performance are extremely lenient, typically one-half standard deviation higher than supervisor ratings (Harris & Schaubroeck, 1988) and they do not converge with supervisor ratings of performance. For example, based on a sample of 18 studies Kraiger (1986) found only an average correlation of .219 between self and supervisor performance ratings. This strongly suggests that self-reports may be inadequate criterion measures of performance. A second methodological issue centers on the latent constructs assessed by the measurement scales used in this study. Xiao did not conduct a factor analysis to confirm the dimensionality of the scales used to measure hypothesized constructs. In the absence of an empirical determination of the number of constructs underlying a set of items it is dangerous to assume that the items reflect the intended construct (DeVellis, 1991). It is equally plausible that the items reflect several more specific constructs, or some other construct altogether.

Holton (1996) argued the need for a theory of training evaluation, criticized current evaluation models (e.g., Brinkerhoff, 1987; Kirkpatrick, 1987) as being taxonomies that fail to account for the effects of intervening variables or adequately specify causal relationships, and presented an integrated training

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

evaluation research and measurement model based on current research and theory. The proposed model recognized that a complex array of relationships can exist between a number of training related variables and their impact on the primary outcome measures of learning, individual performance, and organizational results. Holton argued that it is crucial for this "complex system of influences on training outcomes" (p. 8) to be specified and measured if training is to be accurately evaluated and barriers to training effectiveness correctly diagnosed.

Holton's (1996) model (figure 11) hypothesized that training outcomes are a function of three primary influences (ability/enabling elements, motivational elements, and environmental elements) and a number of secondary influences such as personality or job attitudes. Primary influences have the potential to directly impact outcomes. For example, learning is shown to be a function of trainee motivation to learn, reaction to training, and ability. Individual performance is directly affected by learning, motivation to transfer, transfer climate, and transfer design. Organizational results are a product of individual performance, expected utility of training, external events outside the realm of training, and the degree to which training or other intervention goals are linked to organizational goals.

Secondary influences are seen as exerting their effect indirectly, most notably through their impact on trainee motivation to learn or transfer. In addition, a number of secondary influences are proposed that are a function of the interrelationship between variables. For example, the model specifies a

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

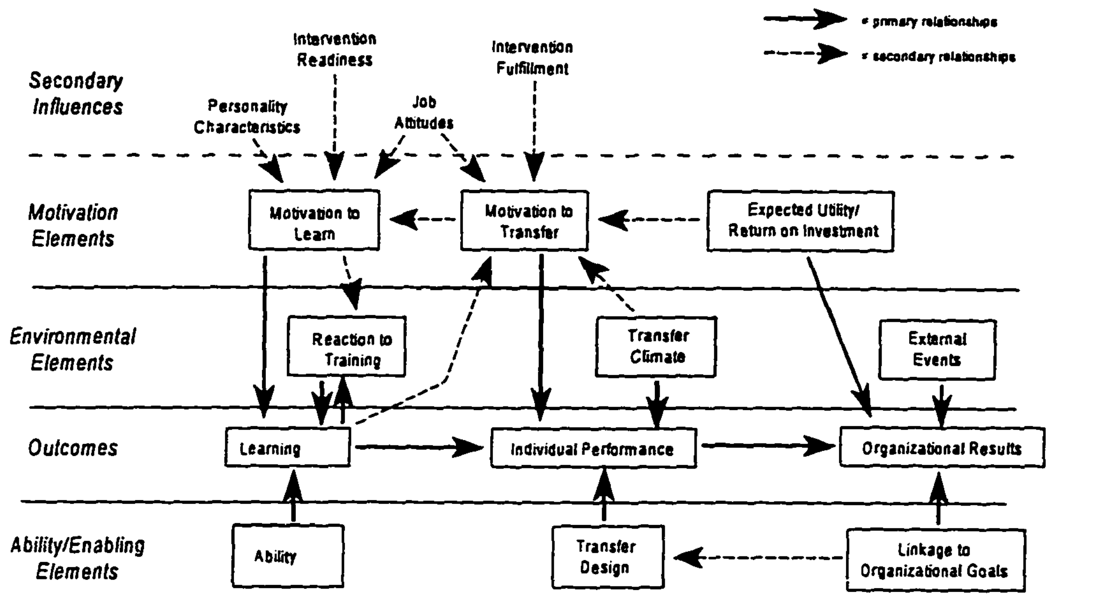


Figure 11: HRD Evaluation Research and Measurement Model (from Holton, 1996)

positive relationship between learning and motivation to transfer, favorableness of transfer climate and motivation to transfer, expected intervention utility and motivation to transfer, and the degree to which interventions are linked with organizational goals and the extent to which they are designed to facilitate transfer. Finally, as suggested by other research (Noe & Schmitt, 1986; Mathieu et al., 1992) reactions to training are hypothesized to moderate the relationship between motivation to learn and learning outcomes.

Holton (1996) suggested that this model can be used to evaluate the outcomes of HRD interventions at the individual level (e.g., learning and performance) as well as at the organizational level. Although this requires a change in the level of analysis from the individual level, organizational level outcomes can similarly be conceptualized as a function of ability (i.e., the extent to which they linked with organizational goals), motivation (i.e., the potential for

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

a return on investment), and environmental influences external to the intervention itself such as employee turnover, price changes, shortages of raw materials and so on. The model also specifies a new and potentially important variable in the training effectiveness/training transfer equation. The model suggests that transfer design mechanisms (e.g., opportunity to practice, relapse prevention, goal setting) included in the design of training have a direct influence on training transfer.

One shortcoming of the Holton (1996) model, however, is its failure to include other training design variables (e.g., use of instructional objectives, use of adult learning principles, identical elements) although the potential importance of these variables in fostering learning and performance either directly (e.g., through the degree of similarity between training and job tasks) or indirectly (e.g., through the effects of training relevance on motivation) is strongly suggested in the literature. Nevertheless, this model includes a high degree of specification and represents one of the most comprehensive integrations of relevant variables into a model of training effectiveness that has yet been proposed. The model has not been empirically tested and research is therefore needed to test its explanatory power, validate the basic components of the model, identify and classify the relationships between variables, and identify which specific variables, within each primary and secondary element, are the most critical in determining training effectiveness (Holton, 1996).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Summary

The models discussed here indicate that a wide range of individual variables, cognitive and motivational processes, and environmental factors can impact transfer of training. For example, research by Noe and Schmitt (1986) and Mathieu et al. (1992) suggested that trainee reactions to training may either mediate or moderate relationships between intervening variables and training outcomes. Learning was shown to be related to transfer behavior (Rouiller, 1989; Rouiller & Goldstein, 1993) and self-reported increases in productivity (Xiao, 1996). Trainee characteristics including age (Hastings, 1994), self-efficacy (Gielen, 1995), and confidence (Ameel, 1992) were identified as important factors influencing training transfer. Two studies (Ameel, 1992; Gielen, 1995) found perceived relevance of training a significant design variable supporting transfer. Several studies uncovered work environment factors such as supervisor support, rewards, and opportunity to perform that support Rouiller and Goldstein's (1993) finding that shared perceptions of specific organizational elements (i.e., transfer climate) can facilitate transfer. In addition, results of the Tracy et al. (1995) study strongly suggested that an organization's continuous learning culture, or the shared perceptions about a broad, comprehensive set of organizational elements (e.g., values and beliefs) can also play a role in transfer.

Only limited research has been done with these models and none have been validated by further research. Several issues in these studies such as findings based on correlational analysis, inadequate criterion measures (e.g.,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

self-reports of transfer behavior), questionable scale content in the absence of factor analysis to confirm the dimensionality of the items and scales used to measure hypothesized constructs, and potentially unreliable construct measures (e.g., constructs measured with one item) suggest that many of these findings can only be regarded as preliminary evidence of model validity. Consequently, our understanding of the transfer of training process is still greatly restricted.

Research aimed at building comprehensive models of the transfer of training process is still in its early phases. As this research progresses, the need for more appropriate and informative data analysis techniques will become necessary. Although multiple regression analysis will continue to provide valuable empirical data, the goal of research aimed at understanding the complex of variables and interrelationships which determine training effectiveness should be the use of more advanced procedures such as path analysis or structural equation modeling. These procedures require large sample sizes but they (a) allow for the estimation of multiple causal relationships between independent and dependent variables even though a dependent variable may become an independent variable in another relationship; and (b) can represent unobserved concepts in these relationships (Hair, Anderson, Tatham, & Black, 1995).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER 3: METHOD

This cross-sectional study was part of a larger study undertaken to evaluate a large scale computer-based training system project, the Computer-Aided Training System (CATS) project. The larger evaluation study was conducted by a three person team from Louisiana State University School of Vocational Education (hereafter referred to as the CATS evaluation team) that was contracted for this purpose. The author was a member of this team.

The goal of the CATS project was the development and implementation of a computer-based training (CBT) system designed to meet the short- and long-term training and information management needs of a large petrochemical producer in southern Louisiana. The project addressed three substantive issues. First, it was a response to the need to provide an efficient and effective medium for the continuous training of production employees and related personnel. For example, the production units in the manufacturing facility may had in excess of 500 standard operating procedures which document and guide the manufacturing and safety processes. On the average, one-third of the procedures change every year creating a significant need for continuous production employee training and re-training in response to procedural changes. In the past, using conventional training methods, meeting these training needs was a costly and time consuming endeavor: Training expenses have added an additional 12% in overtime costs. Much of this expense was eliminated by providing effective on-demand CBT that employees could access during their on-shift free time that occurs in the course of normal production cycles.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Second, the organization had a pressing need to devise and implement an information management system to handle the tremendous daily information requirements of a chemical production facility. Up-to-date and easily accessible operating procedures, material safety data sheets, manufacturing procedures, site procedures, safety procedures, production information, drawings, blueprints and so on are essential for the safe and productive operation of the plant. A computer-based data management system provided the requisite accessibility, reference, and storage capabilities to meet this need.

Finally, with the introduction into law of OSHA 1910-119 (the so-called Bhopal Law) the onus was placed on manufacturing facilities like the one in this study to meet stringent training and certification criteria for personnel involved in the management and use of highly hazardous chemicals. OSHA 1910-119 mandates three areas of training and certification:

1. Initial training - by May 15, 1995 all production employees involved in the management and use of highly hazardous chemicals were required to undergo initial training, testing and certification covering the background of all production processes in the plants as well as job-specific training including process, safety, and environmental training.

2. Refresher training - all production employees are required to undergo refresher training in which they are re-trained, tested, and re-certified in the above areas every three years.

3. Management of change - when operating procedures or other process changes are made in the production cycle all responsible parties

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

affected by the change must undergo training, testing and certification with regard to that change before the change can be implemented and production initiated.

As a result of the OSHA statute, the organization searched for a way to introduce system updates, make these immediately and widely available, and to be able to train, test and certify personnel on-the-spot with regard to the changes. A computer-based information management and training system was chosen for this project because of its information capabilities, cost effectiveness, and the reputation that CBT had for effectively and efficiently achieving learning outcomes. A design team of plant operations personnel was assembled and, with the aid of an off-the-shelf CBT authoring package, developed the computer-based training system. Training was therefore changed from traditional day-long classroom sessions completed on overtime to twenty minute computer-based modules. The modules were completed during on-shift idle times on computer terminals installed in unit control rooms. Implementation of the CBT system commenced in January, 1994.

Subjects

The subjects for the present study were production operators in two production units, the Hydrogen Cyanide unit (HCN) and the Herbicide Production Facility (HPF) of the plant. Production operators in these two units were responsible for monitoring, operating, and maintaining the production equipment used to produce a variety of chemical products. Operators were required to complete from 30 to over 100 training modules depending on their

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

job responsibilities by May 15, 1995 in order to meet the federal certification requirements for the management and handling of highly hazardous chemicals. Following the completion of training in May, 1995, the data collection instruments used in this study were administered.

A Conceptual Model of Training Transfer

The conceptual model of transfer presented in figure 12 was used as a guide in the analysis and interpretation of data in this study. The model was drawn from an integrated evaluation model proposed by Holton (1996) and represents a subset of the elements specified in that model with the addition of a training design variable (content validity) not included in that model. Holton's model described an individual's training related behavior as a function of ability/enabling elements (e.g., ability, transfer design), environmental elements

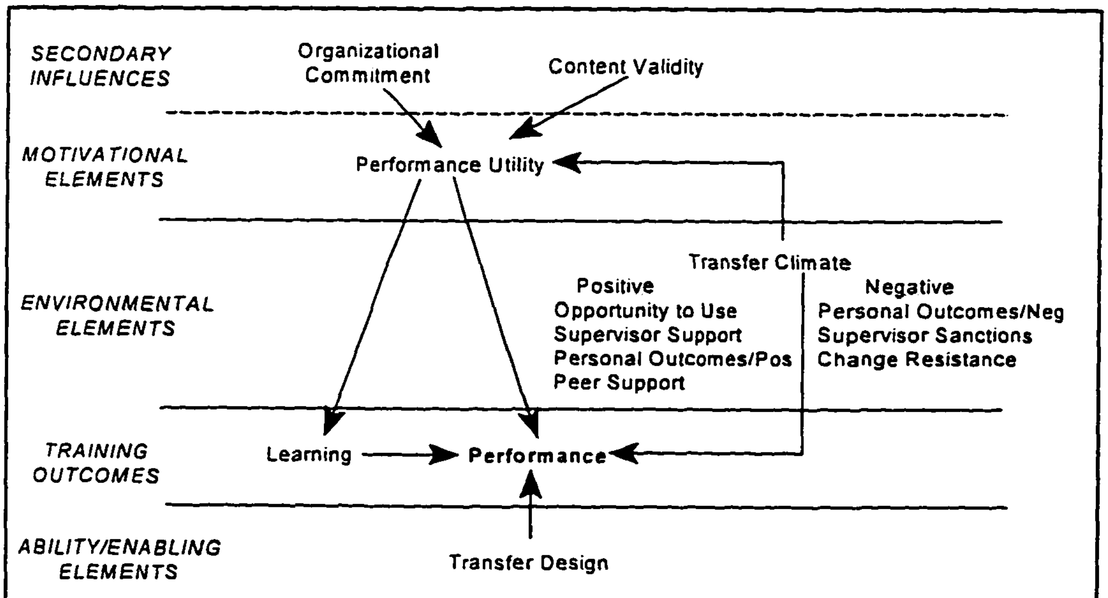


Figure 12: A Conceptual Model of Transfer

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

(e.g., reaction to training, transfer climate, external events), motivational elements (e.g., motivation to learn or transfer, expected return on investment), and secondary influences such as job attitudes or personality characteristics. For the present study, ability/enabling elements were represented by a transfer design construct; environmental elements by transfer climate (supervisory support, opportunity to use, peer support, resistance, personal outcomes negative, personal outcomes positive, and supervisor sanctions); secondary influences by trainee characteristics (organizational commitment) and a training design variable (content validity). Motivational elements were represented by performance utility.

Despite the construction of questionnaire items intended to measure general motivation to learn and motivation to transfer neither of these constructs emerged in the factor analysis of questionnaire items used in this study (see Holton, Seyler, & Bates, 1996b). Since motivational elements are key to understanding training effectiveness (Baldwin & Ford, 1986) and are a central element in the Holton (1996) model as intervening variables between enabling, environmental, and secondary influences and learning and performance, performance utility was used as a measure of two dimensions of training related motivation. Items in this scale (see Appendix A) included, for example, "I plan to use what I learned on the job" , "Because of training, I understand better why it is important to do certain procedures as specified in the SOPs", and "I believe the training will help me do my job better". These items are reflective of the performance utility of training as well as an

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

individual's intent to use training and are therefore seen as indicative of these dimensions of training related motivation.

The rationale for the use of performance utility as a measure of training related motivation comes from several sources. First, some authors (e.g., Noe, 1986) have suggested that performance utility moderates the relationship between learning and behavior change and is therefore an integral part of motivation to transfer. Huczynski and Lewis (1980) used self-reports of trainees' perception of the usefulness of training to gauge motivation to transfer training. Kanfer & Ackerman (1989) noted that perceptions of the performance utility of training have been conceptualized as a key component in the decision to use training. Locke (1968) summarized the research on the relationship between goals, intentions, and performance and found substantial evidence that intentions are important determinants of task performance. In research investigating the individuals' readiness to use computers, Hill, Smith, and Mann (1987) found that behavior intentions were significant predictors of behavior.

Several theoretical perspectives also support the use of performance utility as a measure of motivation to transfer. Adult learning theory suggests that adults are more motivated to devote energy to an activity they perceive will help them perform tasks or solve problems (Cohen, 1990; Knowles, 1980; 1990). Similarly, expectancy theory (Vroom, 1964) suggests that level of motivation both to learn and transfer will be positively associated with an individual's expectancy that effort will lead to performance and performance to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

an expected outcome. From both of these theoretical perspectives, the perceived performance utility of training content can be conceptualized as one dimension of training related motivation: Trainees who perceive training content to accurately reflect their performance needs will be more motivated to learn and transfer that learning.

To summarize, motivation to transfer training includes components of perceived usefulness as well as the intention to use training on the job. The performance utility scale used in this study includes items relating both to intent to use and to the perceived usefulness of training.

Independent Variables

With the exception of the learning measure, the independent variables examined in this study were identified, through the use of factor analysis, as scales on one of three questionnaire instruments: the Transfer Climate, Reaction to Training, and Job Attitudes instruments. The factor analysis of these instruments was based on samples taken from the present organization that were considerably larger than that available for the present study. For example, factor analysis of the Transfer Climate and Job Attitudes instruments was based on an initial sample size of 212 and that for Reaction to Training had n = 142 (for a detailed description of the scale development procedure and factor analytic techniques used in this study see Holton et al., 1996b). The latent constructs identified by the factor analysis were measured using five point Likert-type scales with values ranging from 1 (strongly disagree) to 5 (strongly agree). The following section briefly describes these scales.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Organizational Commitment. Noe's (1986) model of motivational influences on training effectiveness suggests that trainee attitudes may enhance or attenuate the impact of training on learning, behavior change, and job performance. The conceptual model for the present study partially tests this hypothesized relationship by examining the relationship between organizational commitment and performance utility and, subsequently, the relationship between performance utility and both learning and transfer behavior. The conceptual model predicts that changes in scores on the organizational commitment measure will be associated with changes in performance utility as the measure of training related motivation used in this study. Thus, scale scores on the organizational commitment scale should be positively correlated with scores on the performance utility scale.

One of the most frequently used and tested measures of organizational commitment is the 15 item Organizational Commitment Questionnaire (OCQ) (Porter et al., 1974). Tests with this scale report estimates of internal consistency (Cronbach's alpha) ranging from .82 to .93 (Mowday, Steers & Porter, 1979). The scale has also been shown to have good discriminant validity (Mathieu & Farr, 1991). An exploratory common factor analysis was conducted on an instrument which included this scale as well as other job attitude scales in an effort to confirm the latent structures being measured for this data set. The results of this analysis identified the questionnaire items comprising the organizational commitment scale used in the present study (see Holton et al., 1996b). An 11 item scale (α = .90) was the result (see Appendix

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

A). This scale included the nine item short form of the OCQ which has been shown to have good reliability (α = .84 to.90) (Mowday et al., 1979) and two additional items (items 1 & 2). The 11 items used in this study consisted of only the positively worded items. Typical items included "I am proud to tell others I am a part of this organization", "I really care about the fate of this organization", and "The organization really inspires the very best in me in the way of job performance".

Content Validity. Content validity was one of two training design variable examined in this study (the other being transfer design). Content validity is a measure of the extent to which trainees judge the content of training to accurately reflect job requirements (Holton et al., 1996a). Content validity is seen as affecting learning through its impact on training related motivation: Trainees who perceive the content of training as highly valid in terms of their job requirements will be more motivated to learn and use that training than with training content viewed as less valid. It was hypothesized that scores on the content validity scale would be positively correlated with scores on the performance utility scale.

The content validity measure was derived as a three item scale (see Appendix A) with α = .74 on a questionnaire instrument designed to measure transfer climate (see Appendix B). Scale items included, for example, "Equipment illustrated in the training does not operate the same way as the equipment in this unit" and "Skills and knowledge taught in the training are the same skills and knowledge needed to do a good job".

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

<u>Performance Utility.</u> Performance utility refers to trainees' judgements about the extent to which what is taught in training facilitates workplace performance. The performance utility measure used in this study was derived as a seven item scale (see Appendix A) with $\alpha = .89$ on a questionnaire instrument designed to measure employees' reaction to training (see Appendix B). Items typical of the scale included "I plan to use what I learned on the job", "I believe the training will help me do my job better", and "The training covered areas I needed training on".

<u>Learning.</u> Learning is defined as ". . . the relatively permanent change in thought or action that results from practice or experience" (Howell & Dipboye, 1986, p. 306). Learning in this study is measured by employee test scores on computer-based exams designed to measure the extent to which standard operating procedures have been learned. At least three major reviews have firmly established that training and the learning that occurs therein can be effective at producing changes in individuals' behavior and job performance (Campbell, Dunnette, Lawler, & Weick, 1970; Goldstein, 1980; Wexley, 1984). This research suggests that to the extent learning occurs as a result of training it can influence training transfer. The conceptual model used here portrays learning as a training outcome variable that will be positively correlated and will explain a significant proportion of the variance in performance.

<u>Transfer Design.</u> Transfer design refers to the degree to which transfer mechanisms are a part of the training design. This construct reflects the extent

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

to which training has been designed to give trainees the ability to transfer learning to job application (Holton, 1996). In the present study, transfer design is hypothesized to be positively correlated with, and to explain a significant proportion of the variance in performance. The transfer design construct emerged as a five item scale (see Appendix A) with $\alpha = .89$ on a questionnaire designed to measure transfer climate (see Appendix B). Items on this scale included, for example, "During CATS training I am taught how to use my new skills in assigned units" and "During CATS training I practice using skills taught".

Transfer Climate. Because no generally accepted transfer climate instrument could be located, an instrument was developed specifically for this project (see Holton et al., 1996b for a complete description of the instrument development process and findings). Briefly, Rouiller and Goldstein's (1993) transfer climate instrument was used as a prototype based on the strong results obtained in their study, the extensive work they did developing a theoretical framework to support the instrument, and the reported high content validity of the scales. However, results reported by Holton et al. (1996a) suggested that Rouiller and Goldstein's hypothesized structure of transfer constructs was generally not supported. Rouiller and Goldstein's (1993) structure hypothesized that transfer climate was perceived through psychological cues (i.e., goal cues and social cues). The Holton et. al (1996a) analysis found that trainees perceived transfer climate according to the referent in the organization

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

(e.g., supervisor, peer/task, or self). Moreover, even the macro structure of situational cues and consequences proposed by Rouiller and Goldstein was called into question by this analysis due to the inconsistent loading pattern of items representing different constructs. These results led to the use of a revised set of scales for the present study.

The revised set of scales retained 49 items from Rouiller and Goldstein's (1993) original 63 item questionnaire. Fourteen items from the original instrument were deleted because they were not appropriate for this organization. The items retained from the original instrument were used verbatim where possible, but some were revised to reflect appropriate terminology for the present organization and the type of training being conducted. The changes, when made, were not believed to alter the underlying constructs measured by the items.

Eighteen items were then added to complete the final 66 item instrument used in the present study. Based on research suggesting that opportunity to perform is an important transfer climate variable, and one which was not included in Rouiller & Goldstein's (1993) instrument, seven new items were added to assess this construct. Other items were added to strengthen certain scales including transfer design (2 items), involvement in needs assessment (1 item), and content validity of training (1 item). Finally, four social cue items from Rouiller and Goldstein's original pool of 300 items and two new social support items were added because they were particularly appropriate for this work environment. In the final transfer climate instrument (see Appendix B) the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

number of items per scale ranged from 3 (negative feedback) to 18 (social cues).

An exploratory common factor analysis was conducted to identify the underlying latent structure of the data. Analysis of the item content and the original proposed theoretical framework led to the identification of nine factors. Eight of the nine factors exceeded Nunnally & Bernstein's (1994) suggested minimum reliability of at least .70 for scales in early stages of development. Reliability estimates ranged from .68 to .95 with an average alpha of .79. The following scales emerged as a result of the factor analysis:

1. Supervisor Support - refers to the extent to which supervisors reinforce and support use of learning on the job. This scale consisted of 23 items with $\alpha = .95$.

2. Opportunity to Use - refers to the extent to which trainees are provided with or obtain resources and tasks on the job enabling them to use the skills taught in training. This seven item scale had $\alpha = .86$.

3. Transfer Design - refers to the extent to which training has been designed to give trainees the ability to transfer learning to job application and the training instructions match the job requirements. The scale was composed of five items with $\alpha = .89$.

4. Peer Support - refers to the extent to which peers reinforce and support use of learning on the job. Examples include setting goals to use learning, giving assistance, offering positive feedback, and having similar equipment as used in training. This seven item scale had $\alpha = .83$.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

5. Change Resistance - refers to the extent to which the prevailing group norms are perceived by the trainee to resist or discourage using new skills. This scale was composed of five items with $\alpha = .72$.

6. Supervisor Sanctions - refers to the responses made by supervisors which oppose or discourage the use of training on the job. These may include negative feedback, punishment, and no feedback at all. This scale was composed of six items with $\alpha = .74$.

7. Personal Outcomes - Positive - refers to the degree to which applying training on the job leads to outcomes that are positive payoffs for the individual. These may include raises, advancement, etc. This scale was composed of three items with $\alpha = .70$.

8. Personal Outcomes - Negative - refers to the degree to which applying training on the job leads to outcomes that are negative for the individual. These may include reprimands, being overlooked for raises, and so on. This scale was composed of two items with $\alpha = .68$.

9. Content Validity - refers to the extent to which the trainees judge the content of the training to accurately match the job. This scale was composed of three items with $\alpha = .74$.

The conceptual model used in this study hypothesized that scores on the supervisory support, opportunity to use, peer support, and personal outcomes/positive scales will be positively correlated with performance. Scores on the supervisor sanctions, personal outcomes/negative, and change

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

resistance scales were predicted to be negatively correlated with performance. Taken together, this set of transfer climate variables is expected to explain a significant proportion of the variance in job performance.

Dependent Variable

Performance. Performance is the dependent variable examined in this study. Performance was measured using ratings based on supervisors' judgements of the percentage of time that operators performed each procedure in a subset of approximately 20 critical procedures 100% correctly. A standard of 100% correct was selected for this study because this is the performance standard required by the organization as well as by federal regulations. For the purposes of this study, a procedure done 100% correctly is one whose performance included all of the steps done in the correct order as recorded in the written procedure presented by CATS.

Performance Measurement Methodology. A number of performance measurement methodologies were considered for the present study. One of the first options considered was to have supervisors, during the normal course of a work day, conduct workplace observations (e.g., using a checklist) of operators performing the critical procedures of interest in this study. However, discussion with subject matter experts (SMEs) at the facility disclosed that this approach to performance measurement may introduce undue bias into the results. The researcher was advised that operators would almost certainly alter their job behaviors if they knew they were being observed by supervisors for evaluative purposes. For example, the researcher was informed that operators

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

who normally performed procedures in a "short-cut" fashion would be more likely to perform the procedure according to the standard written guidelines when being observed.

The use of peer ratings was also considered. Again, experience in the units in addition to discussion with SMEs indicated that extremely strong within-unit cultures that emphasized protecting ones' self and ones' workgroup from adverse consequences or job evaluations argued strongly against this methodology. This work culture factor, along with research showing self-ratings to be extremely lenient (i.e., self-raters tend to evaluate their own performance higher than do their supervisors) (Harris & Schaubroeck, 1988), also argued against the use of self ratings.

Conceptually, the performance measurement process used in this study involved identification of a subset of critical tasks on which operator performance was frequently observed by supervisors, and collection of supervisory judgements of percentage of time these tasks were done as specified in the CATS training. In practice, the development and implementation of this measurement process becomes rather complex. A summary outline of the process is presented in Table 3 and described below.

1. Procedure Identification. Production units in this organization operate using a unit-specific set of standard operating procedures (SOPs) which detail the manufacturing, site, safety, and other procedures needed to run the unit. Unit operators undergo training on these procedures and are required to demonstrate mastery of each procedure as a requisite for performing the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 3: Summary of the Performance Measurement Process

1. Procedure Identification - A comprehensive list of procedures is identified and collected for each unit participating in the study.
2. Identification of Selection Criteria - Criteria to be used for selecting procedures most critical to operation of production units are identified and defined.
3. Identification of Critical Procedures - A process of selecting and validating a sample of critical procedures using the Critical Procedures Worksheet (CPW).
4. Critical Procedure Frequency Rating - Using the Procedure Observation Questionnaire (POQ) supervisors rate and rank the critical procedure sample according to the frequency with which procedures are observed.
5. Final List of Critical Procedures - A subset of most frequently observed critical procedures is identified.
6. Development of the Transfer Questionnaire (TQ) - The TQ is developed using the subset of critical procedures.
7. Performance Rating - Supervisors make summary judgements of operator performance using the Transfer Questionnaire.

procedure on the job. In short, the set of operating procedures for each unit includes the subset of knowledge, skills, and behaviors operators are expected to transfer from training to the job. As a requisite for examining and measuring successful performance in this study it was therefore necessary to start with a comprehensive of list of SOPs for each production unit (see Appendix F). These lists were obtained from the organization's computer-based training and information management system.

2. Identification of Selection Criteria. Activities in the production units can involve several hundred SOPs. The first step in the performance measurement process was to select a subset of key procedures from the total list of SOPs expected to influence job performance. This subset was labeled

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

critical procedures. Three general criteria were identified for use in the critical SOP selection process based on consensus from a group of subject matter experts. A summary of these criteria are presented in Table 4.

Table 4: Critical Procedure Selection Criteria

1. The procedure must be tied to an observable behavior.

2. The procedure must be performed either:
   (A) Every 12 hour shift.
   (B) Every three day working cycle.
   (C) At least once a month.

3. The procedure must be critical to the performance of the unit in terms of either:
   (A) Safety - nonperformance results in a threat to safety.
   (B) Quality - nonperformance negatively effects product quality.
   (C) Production rates - nonperformance negatively affects production rates.

* Non-performance refers to the performance of a procedure that is not 100% in accordance with the written SOP.

The first selection criterion specifies that the SOPs used in the performance measurement process must be tied to an observable job behavior. For example, SOPs which were strictly informational in nature or otherwise not directly linked to an observable job behavior were deleted from inclusion in the critical procedure sample. The rationale was that SOPs tied to observable behaviors facilitated assessment of the extent to which learning is applied on the job. Second, SOPs used in the performance measurement process were required to be regularly performed. Procedures which were rarely or irregularly performed were deleted because of the potential for increased rating error due to the relatively low frequency of performance observation. Emergency procedures, although important to safety and productivity, were deleted because of their infrequent and unpredictable incidence of performance.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

'Regularly performed' procedures were defined as procedures performed either every 12-hour shift, every three-day working cycle (supervisors and operators work rotating shifts, typically with three days on and four days off), or at least once a month. This definition of 'regularly performed' was chosen based on the need to be able to complete measurements on performance within a reasonable period of time. For example, placing a limit of at least once a month on critical procedures excluded procedures implemented as a result of upset conditions due to equipment failure or some other factor. It also excluded procedures that, perhaps critical, were performed only a few times over the course of year or more. Procedures occurring at unpredictable intervals or only very infrequently would have made the performance measurement process unduly long and difficult. It would have required supervisors to remain attentive to and to accurately recall the directives of the performance measurement process for perhaps as long as six months or more. And, in the case of upset conditions, it could have potentially required supervisors to be present for and to recall a single instance of operator performance. Finally, it was possible with infrequently performed procedures that performance ratings for all employees on that procedure would not have been available. Because these factors would have increased rating error, the decision was made to restrict performance measurement to SOPs performed at least once a month.

The third general criterion for selecting a subset of SOPs was the extent to which the procedure was critical to the performance of the unit. Criticality

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

was defined along three dimensions: (a) Safety - whether the nonperformance of a SOP presents a threat to one or more dimensions of safety. Specifically, does nonperformance result in the release of toxic chemicals into the environment, personal injury, or equipment damage or failure? (b) Quality - refers to the influence of SOP nonperformance on product quality: Does nonperformance of the SOP result in contaminants in the final product, unwanted by-products, or rework time for a product that does not meet required specifications? (c) Production rates - whether nonperformance of the procedure impacts production rates. Does nonperformance of a SOP result in a decrease in production rates? For all of these criteria, nonperformance refers to the execution of a SOP that was not 100% in accordance with the procedure as written in CATS.

3. Identification of Critical Procedures. Based on discussions with the CATS development team, two supervisors were carefully selected from each functionally different subunit to serve as SMEs to assist in identifying a sample of critical procedures for their unit or subunit using the SOP selection criteria. For the Tank Farm subunit in HCN only one supervisor was selected because he was the only supervisor for this subunit. To facilitate the critical SOP identification process, the Critical Procedures Worksheet (CPW) was developed (see Appendix C). The CPW asked supervisors to list the most important or critical SOPs in their unit, identify which criteria make the procedure critical (e.g., safety, quality, productivity), and to specify how frequently the procedure is performed. Participating supervisors were asked to

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

complete the worksheet and return it to the investigator in one week. To validate the contents of the initial list of procedures on the CPW for each unit and subunit, the completed worksheet was cross-checked by an additional one to two supervisors. Additions, deletions, and edits were made based on the feedback received from these individuals. The finalized list of SOPs identified as critical by the supervisors constituted the list from which a smaller subset of procedures was chosen. This final subset of procedures constituted the SOPs on which the job performance measure is based.

4. Frequency Rating. To enhance the validity of the performance measures, a procedure was instituted to assess the relative frequency with which supervisors were able to directly observe the performance of each SOP on the critical procedures list. A Procedure Observations Questionnaire (POQ) (see Appendix D) was developed asking supervisors to estimate the percentage of time, of all the times an operator performed a particular SOP, that the supervisor directly observed operator performance. Responses on this questionnaire ranged from 0 (none of the time), 1 (about 25% of the time), 2 (about 50% of the time), 3 (about 75% of the time), to 4 (100% of the time). Responses to this questionnaire were collected from each supervisor in each unit or subunit under study. From each unit or sub-unit, the resulting subset of procedures rated as the most frequently observed was determined by ranking the simple mean ratings of the frequency of observation of each procedure.

5. Final List of Critical Procedures. The 20 procedures with the highest mean ratings of observation frequency were chosen as the final subset of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

procedures for which performance ratings were collected. The number 20 was arrived at through discussion with supervisors who indicated that this would be the maximum number of procedures that they would reasonably be able and willing to provide performance ratings on for all their subordinates given the time constraints imposed by the researcher. If there were more than 20 procedures with the highest mean ratings (e.g., a number of ties), the 20 procedures with the highest mean rating and the highest criticality rating were chosen. The rationale for this methodology is that performance ratings of subordinates on procedures that the supervisors observed most frequently would be more accurate than ratings on procedures less frequently observed. In addition, information relating to the performance of highly critical procedures would presumably be of the greatest importance to the organization.

The researcher chose to provide the raters a period of ten days (i.e., two three-day shifts separated by four off-days) to complete the rating forms. It was the researcher's judgement, based on considerable experience working with supervisors in the units as well as input from SMEs, that a performance rating time period longer than two three-day work shifts could potentially lead to a deterioration in supervisor motivation and willingness to complete the rating process. A period of time shorter than 10 days, on the other hand, may have unduly inconvenienced the supervisors considering the number of ratings some had to complete in addition to their normal workload.

The final subset of 20 critical procedures provided the procedures for which performance measures were collected. All operators in each unit were

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

assessed on the final list of critical procedures selected for that unit. However, some of the operators who were relatively new to the job were not certified on all of the critical procedures used in this study and therefore did not perform all of the critical procedures as a normal part of their job. These operators received performance ratings only on those procedures which they performed.

6. Development of the Transfer Questionnaire (TQ). The Transfer Questionnaire (TQ) (see Appendix E) was developed by the researcher to obtain supervisors' judgements of the percentage of time that operators performed each procedure in a set of critical procedures 100% correctly. The TQ consists of a five point Likert-type scale reflecting judgements about the percentage of time that supervisors have observed procedures being performed by individual operators 100% correctly. The scale ranges from (0) none of the time, (1) about 25% of the time, (2) about 50% of the time, (3) about 75% of the time, to (4) 100% of the time. Attached to the rating instrument were written copies of the critical procedures to be rated. These copies contained a detailed list ordering the steps required for each procedure to assist the supervisor in making accurate summary judgements. The copies of the SOPs attached to the TQ are taken from the SOPs as they appeared in the CATS training material.

7. Performance Rating. The measurement of performance was accomplished using the Transfer Questionnaire which recorded supervisors' judgements of the frequency with which operators performed a subset of critical procedures 100% in accordance with the procedure as written in CATS. To

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

initiate the performance rating process, a meeting was held with each supervisor individually to explain the objectives driving the collection of performance data, the procedure, and the proposed data collection schedule. In this meeting the supervisors were given the following instructions:

1. Complete performance measures for each operator in the unit.

2. The procedures measured are to be judged as correctly performed only if the manner in which they were performed was in 100% agreement with the procedure as written in CATS.

3. If the steps of a procedure are all done correctly, but are not done in the order indicated in CATS, then the procedure must be judged to have been done incorrectly.

4. The purpose of the performance measurement is not to evaluate the job performance of individual employees but to evaluate the effectiveness of the training system for the purposes of program improvement. The supervisors were assured, for example, that the rating forms would not be seen by top management and were only for use in this study.

5. Supervisors are to use only first-hand observational knowledge in making the performance measurements.

6. Should a supervisor be unsure about what rating to give an operator on some procedure, the supervisor should attempt to validate that rating by direct observation.

When it was established that the supervisors understood the objectives and procedures of the performance process and were comfortable with the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

confidentiality of the process, they were given the TQ. The ten day performance measurement period began at the conclusion of this meeting. During the subsequent ten day period the researcher made periodic phone calls or visits to the supervisors to check on progress and to answer any questions that may have arisen. At the end of the ten day period the researcher collected the TQs from the supervisors.

Data Analysis

Descriptive Statistics

Means and standard deviations were computed for all factors scale scores along with mean test scores for learning and performance scores reflecting performance.

Multicolinearity

A key issue that can have a substantial impact on the results of multiple regression analysis is the degree to which predictor variables are correlated with each other, i.e., the degree of multicolinearity among predictors. Multicolinearity can (a) limit the size of the coefficient of determination (R^2) and make it more difficult to increase unique explanatory prediction from additional variables; and (b) make determination of the unique contribution of each predictor difficult to assess because the effects of the predictors are confounded due to their intercorrelation. In short, a high degree of multicolinearity means larger portions of shared variance and lower levels of unique variance (Hair et al., 1995).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Assessment of multicolinearity in the present study followed the methodology developed by Belsley, Kuh, and Welsch (1980). This process utilized (a) the condition index, an index that represents the colinearity of combinations of predictor variables; and (b) the regression coefficient variance-decomposition matrix which describes the proportion of variance for each regression coefficient attributable to each condition index. The multicolinearity assessment process involved identification of all condition indices above a threshold value (30) and identification of variables within those condition indices that account for a substantial proportion (.90 or greater) of the variance for two or more coefficients. Variables with a condition index greater than 30 and which account for .90 or greater of the variance of two or more coefficients are considered to exhibit multicolinearity. This process is reported to provide greater diagnostic power in the assessment of multicolinearity than the more typical methods examining tolerance values or the variance inflation factor (VIF) (Hair et al., 1995).

Diagnostic Analysis

The goal of regression analysis is to estimate the most representative model given sample data, one that best reflects the population from which it was drawn and provides the most valid and generalizable results. The presence of one or more unrepresentative observations in a sample can undermine achievement of this goal (Hair et al., 1995). Deletion of such observations may be desirable in terms of the statistical properties of the parameter estimates as well as the estimate of the final equation (Hocking,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1976). The purpose of a diagnostic analysis is therefore to identify influential observations (i.e., those which have a disproportionate impact on the regression results) and to determine whether those observations should be excluded from the final analysis.

Diagnostic analysis in regression can include the results of several diagnostic statistics including studentized residuals, centered leverage values, DFFITS, and DFBETAS, and Cook's Distance. These statistics are capable of identifying individual outliers (i.e., cases that are inconsistent with the model fitted to the other cases), leverage points, and other influential observations. They do not, however, provide information about the potential influence on the regression analysis of two or more influential observations in combination. In order to assess the relative impact on the regression analysis of multiple influential observations individually and in combination, a variable selection technique using all-subsets regression is useful (see Hocking, 1976; Peixoto & LaMotte, 1989). This analysis identifies the maximum-R^2 subset regression model of each size (e.g., subset regression models with one influential observation deleted, two, three and so on to include all individual influential observations). Subsequent to the identification of a maximum-R^2 subset regression model for each subset size, comparative evaluation of the maximum-R^2 subsets follows a technique described by Hocking (1976). This techniques calculates an F-statistic using the difference in residual sum of squares for each model to identify which subset(s) offer significant improvements in model prediction and estimation.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

This approach to diagnostic analysis is assumed to provide a more discretionary approach to the identification and deletion of unrepresentative observations than the simple elimination of all potentially influential observations.

Tests of Hypotheses

Hypothesis 1 was assessed through a bivariate correlation analysis of the relationship between secondary influences on training effectiveness (organizational commitment and perceived content validity) and performance utility.

Hypothesis 2 was assessed through a bivariate correlation analysis of the relationship between performance utility and transfer climate variables including perceived supervisory support, opportunity to use training, peer support, positive personal outcomes, negative personal outcomes, change resistance, and supervisor sanctions.

Hypothesis 3 was assessed through a bivariate correlation analysis of the relationship between performance utility and learning.

Hypothesis 4 was assessed through a bivariate correlation analysis of the relationship between performance and performance utility, positive transfer climate variables (perceived supervisory support, opportunity to use training, peer support, and positive personal outcomes), transfer design, and learning.

Hypothesis 5 was assessed through a bivariate correlation analysis of the relationship between performance and negative transfer climate variables (change resistance, supervisor sanctions, and negative personal outcomes).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hypotheses 6 through 11 were evaluated using hierarchical multiple regression analysis. The order of entry of variables in this analysis was as follows: organizational commitment, content validity, performance utility, learning, transfer design, and transfer climate. This order of entry was based on the logical sequence of these variables or sets of variables as they appear in the training situation. That is, organizational commitment as a job attitude is entered first because this is an attribute that trainees bring with them into the training situation. Content validity is entered second because trainee assessment of training validity is presumed to be among the first judgements that is made upon entry into training. Performance utility was entered third because trainee assessment of performance utility is made subsequent to experience with training content. Learning is a function of participation in training and is thus entered fourth. Transfer design factors are entered fifth because the introduction of these factors in training occurs either in addition to or subsequent to the presentation of core instructional content. These factors therefore logically follow (or are at least coincident with) learning. Transfer climate variables as a set were entered last in order to determine how much variance this construct accounts for over and above the other variables. Figure 13 graphically portrays the order of variable entry.

By entering these variables in an assigned order increments in the proportion of variance in performance explained by each successive set over and above the influence of preceding sets can be determined. Thus, at each

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

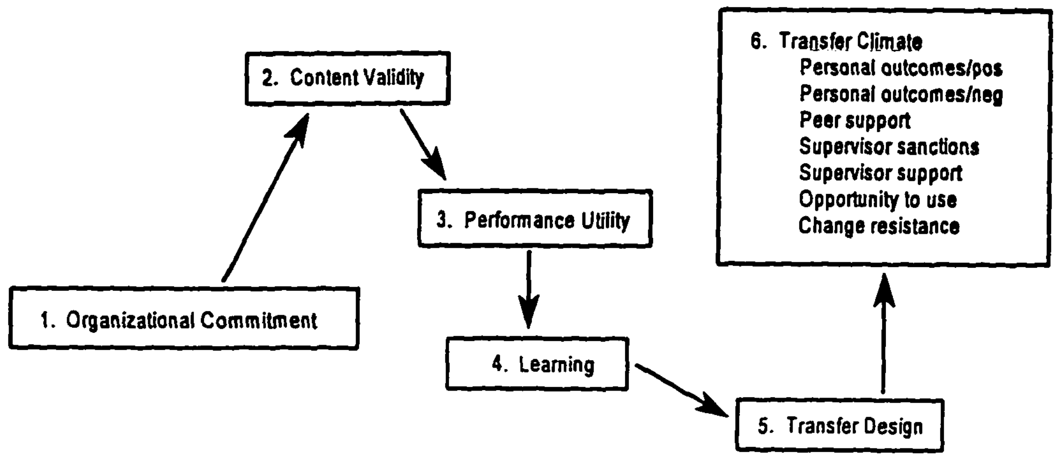


Figure 13: Variable Order of Entry

step the unique partitioning of the total performance variance accounted for by each set of variables can be estimated by examining the R^2 series (Cohen & Cohen, 1983).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER 4: RESULTS

This study was conducted to determine the impact of specific training design variables, trainee characteristics, and work environment factors on the job performance of production operators in a petrochemical manufacturing firm. The independent variables examined in this study were learning, organizational commitment, performance utility, perceived training content validity, transfer design, and transfer climate variables including positive personal outcomes, negative personal outcomes, peer support, supervisor sanctions, supervisor support, opportunity to use, and change resistance. The dependent variable was supervisor ratings of job performance. The relationships between independent and dependent variables were analyzed using bivariate correlation analysis and hierarchical regression analysis.

This chapter, first, describes the general characteristics of the sample studied and, second, reports the results of the statistical analysis for each of the 11 hypotheses.

Characteristics of the Sample

The job performance data for this study were collected from 73 production operators employed by a Fortune 500 size petrochemical manufacturer in southern Louisiana. However, information provided by participants was not always complete across all questionnaire instruments. Several subjects upon whom performance measures were obtained did not complete all of the instruments employed in this study. Observations encountered with missing data values resulted in the loss of that observation

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

from data analysis. In addition, as a result of a regression diagnostic analysis (discussed in the next section of this chapter), three unrepresentative observations were also ultimately omitted from the analysis. Consequently, the sample size of this study was less than 73, with the precise number of respondents analyzed for each hypothesis varying slightly. The descriptive statistics for this sample are summarized in Table 5.

Table 5: Descriptive Statistics

Variable	N	Mean	Standard Deviation
Age	69	41.00	7.86
Performance[1]	70	3.33	.46
Learning Average[2]	70	93.53	3.27
Organizational Commitment[3]	69	3.84	.55
Content Validity[3]	66	3.62	.56
Performance Utility[3]	68	3.68	.59
Negative Personal Outcomes[3]	68	3.17	.77
Opportunity to Use[3]	68	3.57	.53
Peer Support[3]	69	3.78	.52
Positive Personal Outcomes[3]	65	2.97	.71
Change Resistance[3]	68	2.26	.62
Transfer Design[3]	66	3.71	.50
Supervisor Sanctions[3]	68	2.55	.50
Supervisor Support[3]	69	3.52	.55

[1] 0=None of the time 1=About 25% of the time 2=About 50% of the time 3=About 75% of the time 4=100% of the time

[2] The range of possible mean scores was 80 to 100.

[3] 1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree

The participants in this study belonged to one of two production units, HCN (n = 33, 45%) or HPF (n = 40, 55%), in the petrochemical manufacturing facility. Within each of these units there were also two distinct subunits. In

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

HCN, the subunits included the Sequestrene subunit (n = 24) and the Tank Farm subunit (n = 9). In HPF, the subunits included the Atrazine subunit (n = 21) and the CC subunit (n = 19). Taken together, the individuals in these units and subunits were predominantly male (97%), between the ages of 22 and 62, and typically had nearly three years of education beyond high school. Length of job tenure ranged from four months to 26 years with a mean of 13.4 years.

As seen in Table 6, comparison of the HCN and HPF units indicated no significant differences between the units in age, level of rated performance, or education. A significant difference in job tenure did emerge with mean years worked in HCN (15.57) exceeding that of HPF (11.62). Despite the statistical significance of the difference, the mean number of years worked in each of the units was relatively substantial (> 10 years) and only one operator in the units had been employed less than three years at the time of the study. Therefore, this difference was not expected to dramatically influence the results.

Table 6: Comparison of Means for Performance Ratings for HCN and HPF

	HCN Mean SD	HPF Mean SD	F Value$_{df}$	Significance Level
Performance Rating[1]	3.4 .36	3.3 .53	$2.4_{1,68}$	.13 ns
Age	42	40.1	$1.05_{1,64}$	.31 ns
Job Tenure[2]	15.57	11.62	$6.19_{1,68}$	.02
Education[3]	2.9	2.9	$.002_{1,68}$	.96 ns

[1] Performance ratings ranged from 1 (low) to 5 (high).
[2] Job tenure is measured in years worked.
[3] 1=high school graduate 2=less than two years beyond high school 3=Associate degree or two years college 4=college degree (BA or BS)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Both HCN and HPF were continuous production units involved in the manufacture of highly hazardous chemical products. The work performed by the operators in the units was technically similar. Production operators in both units were responsible for monitoring, operating, and maintaining production related equipment such as reactors, filters, grinders, process analyzers, piping, valves, pressure gauges, flow meters, and a computerized process control board. Both production units worked rotating shifts of twelve hour days with four days on and three days off. The number of operators per shift (four to six) in each unit was comparable as was the span of control of the supervisors. In short, based on the demographic, working condition, and technical similarity of the units it was judged that HCN and HPF together provided a relatively homogenous sample.

Test of Assumptions

Regression analysis was used in this study to test the ability of a number of independent variables to predict supervisory ratings of production operators' performance. In conducting multiple regression analysis, several assumptions are made about the relationships between criterion (dependent) and predictor (independent) variables that can affect the least squares statistical procedure. A basic issue is determination of whether these assumptions have been met. The four assumptions to be addressed include (a) linearity of the relationship between criterion and predictor variable(s); (b) constant variance of the error terms (homoscedasticity); (c) normality of the error term distribution; and (d) the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

independence of residuals (Hair et al., 1995). The data were examined to assess the extent to which these assumptions were met.

The linearity of the criterion-predictor relationship represents the degree to which the change in the criterion associated with each predictor variable is constant across the range of values for the predictor variables. Assessment of the assumption of linearity of the present data was based on an examination of a scatterplot of the studentized residuals (see Appendix H) against the predicted values. Examination of the residuals did not show any consistent non-linear pattern which would have suggested a violation of the linearity assumption.

With more than one independent variable in a multiple regression analysis, examination of the residuals only shows the combined effects of all predictor variables. To assess the relationships of each single predictor with the criterion variable, partial regression plots for each predictor against the criterion were also examined (see Appendix H). Again, no consistent non-linear pattern emerged. It was therefore concluded that the assumption of linearity of predictors and criterion was not violated.

The second assumption, that of homoscedasticity or equal variance of the criterion variable across the range of predictor variables, is desirable in multiple regression analysis because the variance in the criterion variable being explained by the dependence relationship should not be restricted to a limited range of predictor values (Hair et al., 1995). This assumption was examined using plots of studentized residuals against the predicted criterion values (see

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Appendix H). Comparison of these plots with a null plot would show a consistent pattern (e.g., increasing or decreasing residuals) if variance is not common. No such pattern emerged in this data suggesting that the equal variance assumption had not been violated.

A normal probability plot (see Appendix H), which compared studentized residuals with a normal distribution, was used to check the assumption of normality of error term distribution. This diagnosis suggested that the residuals fell along the diagonal with no systematic or substantial departures indicating that this assumption had not been violated.

Finally, the assumption of independence of the observations requires that each predicted value be independent of other predicted values (i.e., not sequenced by any variable). When predicted values are not independent, the result is a carry-over effect from one observation to another making the residuals non-independent. An examination of residual plots (see Appendix H) was therefore used to test this assumption. The plots showed that the residuals patterns were random and inconsistent suggesting that the assumption of independence had not been violated.

Taken together, these analyses indicated that serious violations of the basic assumptions of multiple regression analysis did not occur. Satisfying these assumptions helps to ensure that the research findings are representative of the sample and that the best results possible have been obtained (Hair et al., 1995).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Multicolinearity. Analysis of the present data using the multicolinearity assessment approach suggested by Belsley et al. (1980) indicated that, of the five variables with condition indices greater than 30, only the condition index for supervisor support had a variance proportion value greater than or equal to .90 associated with it (.90 for the learning coefficient). However, since supervisor support had but a single variance proportion value greater than .90 associated with it (and at least two are required for multicolinearity), no multicolinearity is shown for this variable. Thus, no substantial multicolinearity problem among the predictor variables is indicated. This data is summarized in Appendix G.

Diagnostic Analysis. Since a diagnostic analysis always addresses a particular regression, the first step in diagnostic analysis is to identify the regression to be run, assuming no irregularities (Darlington, 1990). The diagnostic analysis in this study focused on a regression model which included twelve predictors (organizational commitment, training content validity, performance utility, learning, transfer design, positive personal outcomes, negative personal outcomes, peer support, supervisor sanctions, supervisor support, opportunity to use, and change resistance), with performance ratings as the criterion and an initial regression sample size of 65. Analysis of the results of several diagnostic statistics derived from this data, including studentized residuals, centered leverage values, DFFITS, and DFBETAS, and Cook's Distance, indicated the presence of five potentially influential observations. In order to assess the relative impact of these five observations

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

individually and in combination on model estimation, an all subsets regression was run (Hocking, 1976; Peixoto & LaMotte, 1989).

With five influential observations being examined, a total of 32 possible regression models were identified with subsets for models with zero, one, two, three, four, and five variables deleted. From these models, the model from each of the five subsets with the maximum R^2 was identified. To compare the relative effect of these maximum R^2 subset models on regression estimation, an F-statistic was computed for the difference in residual sum of squares for the five models plus the full model (no deletions) using the formula

$$F_{df} = \frac{\text{Residual } SOS_A - \text{Residual } SOS_B}{\sigma^2}$$

where Residual SOS_B is the residual sum of squares of the model with X observations deleted, Residual SOS_A is the residual sum of squares of the model with X - 1 observations deleted, σ^2 is the residual mean square for the full model, and df = 1, n -1 - total predictors - total outliers being tested (Peixoto & LaMotte, 1989).

This approach assumed that the last model in a progressive comparison procedure to produce a significant F-statistic indicates the appropriate combination of influential observations to be deleted from the analysis (see Hocking, 1976). As seen in Table 7, the last significant ($p \leq .05$) F-statistic occurs when the model with two observations deleted is compared with the model with three observations deleted. This suggests that the model with three

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

observations deleted is the most appropriate model for the final regression analysis. Deletion of these observations reduced the final sample size to 62.

Table 7: Comparison of F-statistics for Maximum R^2 Subsets

Models Compared	$F_{1,45}$
Full Model v Delete Case 41	10.32*
Delete Case 41 v Delete Cases 41 & 68	11.72*
Delete Cases 41 & 68 v Delete Cases 41, 45, 68	4.99*
Delete Cases 41, 45, 68 v Delete Cases 41, 45, 53, 68	3.91
Delete Cases 41, 45, 53, 68 v Delete Cases 41, 45, 46, 53, 68	3.67

* $p \leq .05$

Examination of Specific Hypotheses

Eleven specific hypotheses were posed to examine the relationships between secondary influences on training effectiveness (organizational commitment, perceived training content validity), motivational elements (performance utility), enabling elements (transfer design), transfer climate elements (positive and negative personal outcomes, peer support, supervisor support, supervisor sanctions, opportunity to use training, change resistance), learning, and performance ratings. Bivariate correlation analysis was used to determine the degree to which various combinations of these variables covaried with each other in this setting. Hierarchical regression analysis was conducted to determine the extent to which these variables, individually and in sets, accounted for the variance in job performance ratings on a specific set of critical operating procedures.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Bivariate Correlation Analyses

Hypothesis 1: There is a significant positive correlation between secondary influences on training effectiveness (organizational commitment and content validity) and performance utility.

Pearson Product Moment one-tailed correlations yielded statistically significant ($p \leq .001$) positive r values of .42 for the job commitment-performance utility relationship and .53 for content validity-performance utility relationship. Thus, Hypothesis 1 is supported. This finding is summarized in Table 8.

Table 8: Pearson Correlation Coefficients for Relationships Between Performance Utility and Organizational Commitment, Transfer Climate Variables, and Learning Average.

Variable	N	Performance Utility r
Organizational Commitment	67	.42***
Content Validity	64	.53***
Supervisor Support	67	.46***
Opportunity to Use	66	.58***
Peer Support	67	.55***
Positive Personal Outcomes	63	.33**
Supervisor Sanctions	66	-.47***
Change Resistance	66	-.42***
Negative Personal Outcomes	66	-.27*
Learning Average	68	.13

* $p \leq .05$ (one-tailed) ** $p \leq .01$ (one-tailed) *** $p \leq .001$ (one-tailed)

Hypothesis 2: There is a significant positive correlation between performance utility and the positive transfer climate variables (supervisory

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

support, opportunity to use training, peer support, and positive personal outcomes), and a significant negative correlation between performance utility and the negative transfer climate variables (negative personal outcomes, supervisor sanctions and change resistance).

The data yielded statistically significant ($p \leq .001$) positive r values for supervisor support ($r = .46$), opportunity to use training ($r = .58$), peer support ($r = .55$), and positive personal outcomes ($r = .33$, $p \leq .01$). These results demonstrate the predicted significant positive correlation between the positive transfer climate variables and performance utility. One-tailed correlation analysis also yielded statistically significant ($p \leq .001$) negative r values for supervisor sanctions ($r = -.47$), change resistance ($r = -.42$), and for negative personal outcomes ($r = -.27$, $p \leq .05$). The data therefore confirm the predicted negative correlations between the negative transfer climate variables and performance utility. The data thus support Hypothesis 2. These results are summarized in Table 8.

<u>Hypothesis 3:</u> There is a significant positive correlation between performance utility and learning.

A Pearson Product Moment one-tailed correlation yielded a non-significant positive r value of .13 for this relationship. Hypothesis 3 is therefore not supported: The data do not show that performance utility is significantly correlated with learning (see Table 8).

<u>Hypothesis 4</u>: There is a significant positive correlation between performance and performance utility, supervisory support, opportunity to use

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

training, peer support, positive personal outcomes, transfer design, and learning.

One-tailed correlation analysis showed r values ranging from -.10 to .19. The only significant correlation found was between peer support and performance ($r = .22$, $p \leq .05$). These results, however, do not show that performance utility, learning, supervisor support, opportunity to use training, positive personal outcomes, or transfer design are positively correlated with performance. Hypothesis 4 was therefore not supported (see Table 9).

Table 9: Pearson Correlation Coefficients for Relationships Between Performance and Performance Utility, Learning, Organizational Commitment, and Several Transfer Climate Variables.

Variable	N	Performance r
Performance Utility	68	.07
Learning Average	70	-.08
Organizational Commitment	69	.00
Supervisor Support	69	-.06
Opportunity to Use	69	.03
Peer Support	69	.22*
Positive Personal Outcomes	65	.13
Negative Personal Outcomes	68	-.11
Transfer Design	66	.04
Change Resistance	68	.18
Supervisor Sanctions	68	.31**

* $p \leq .05$ (one-tailed) ** $p \leq .01$ (one-tailed)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hypothesis 5: There is a significant negative correlation between performance and negative personal outcomes, change resistance and supervisor sanctions.

Contrary to expectations, Pearson Product Moment one-tailed correlations yielded positive r values for the supervisor sanctions-performance ($r = .31$, $p \leq .01$) and change resistance-performance relationships ($r = .18$ns). Negative personal outcomes was negatively correlated with performance but the association was not significant ($r = -.11$ns). These results (see Table 9) show that hypothesis 5 was not supported.

Figure 13 graphically summarizes the results of the correlation analyses addressing hypotheses 1 through 5. In general, the results were mixed. As indicated by the solid lines, the figure shows that hypotheses 1 and 2 were supported by the data. For hypothesis 1, secondary influences on training effectiveness (organizational commitment and content validity) were significantly correlated with performance utility. In the case of hypothesis 2, a strong significant positive correlation between performance utility and the positive transfer climate variables (supervisor support, opportunity to use training, peer support, and positive personal outcomes) was found. The hypothesized negative correlations between performance utility and the negative transfer climate variables (negative personal outcomes, supervisor sanctions and change resistance) were also shown. Dashed lines in the figure indicate that no support was found for a positive correlation between performance utility and learning (hypothesis 3); a positive correlation between

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

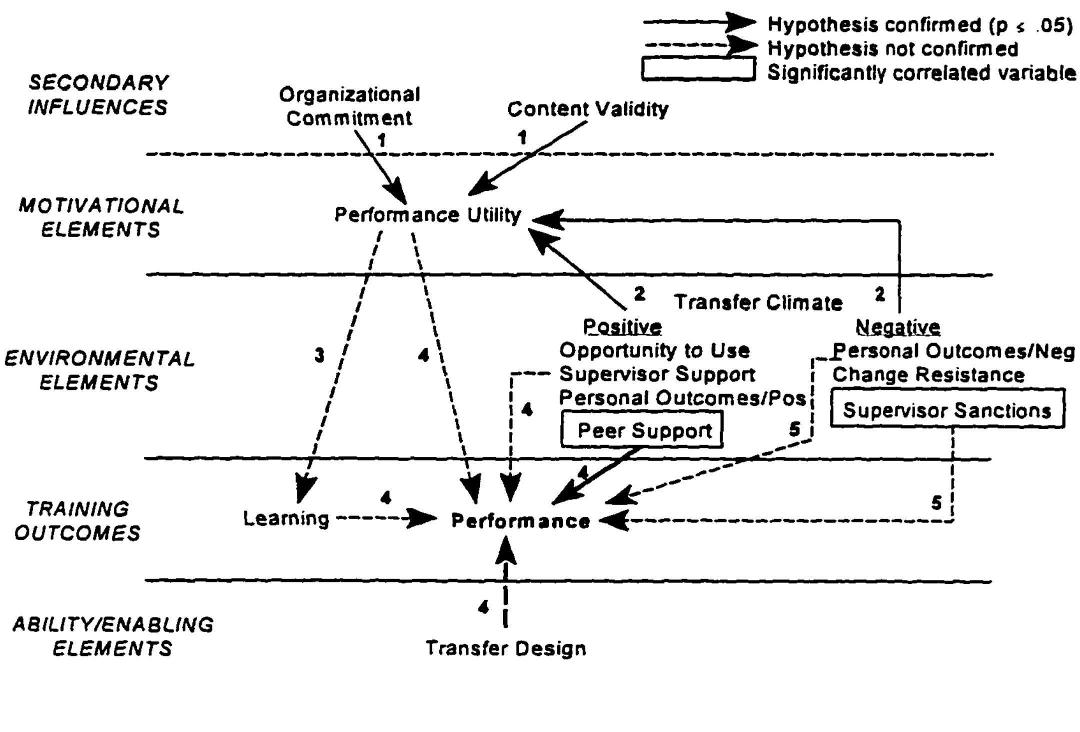


Figure 14: Summary of Correlation Results

performance ratings and performance utility, supervisory support, opportunity to use training, positive personal outcomes, transfer design, or learning (hypothesis 4); or a negative correlation between performance ratings and negative personal outcomes, change resistance and supervisor sanctions (hypothesis 5). For hypothesis 4, the only significant correlation found was that between peer support and performance ($r = .22$, $p \leq .05$). In the case of hypothesis 5, the only significant finding was one contrary to that expected: Supervisor sanctions were hypothesized to be negatively correlated with performance ratings but data showed a significant positive correlation ($r = .31$, $p \leq .01$).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hierarchical Regression Analysis

Hypothesis 6: Organizational Commitment explains a significant proportion of the variance in performance ratings.

The results of the regression analysis indicated that organizational commitment accounted for .4% ($R^2 = .004$) of the variance in performance ratings. This finding is not significant at the .05 level. Hypothesis 6 is therefore not supported: The data did not show that organizational commitment explained a significant proportion of the variance in employee performance ratings. This finding is summarized in Table 10.

Hypothesis 7: Content validity explains a significant proportion of the variance in performance after the variance explained by organizational commitment has been accounted for.

The results of the regression analysis indicated that, after the variance explained by organizational commitment is accounted for, content validity increased the proportion of variance explained by 5.9%. This increase approached significance ($p \leq .06$) but, as shown in Table 10, neither this finding nor the total variance in performance ratings explained by organizational commitment and content validity combined (6.3%, $R^2 = .063$) is significant. The data therefore did not support Hypothesis 7.

Hypothesis 8: Performance utility explains a significant proportion of the variance in performance ratings after the variance explained by organizational commitment and content validity has been accounted for.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 10: Results of the Hierarchical Regression of Organizational Commitment, Content Validity, and Performance Utility on Performance

	Step 1					Step 2					Step 3				
Variable	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)
Organizational Commitment	-.06	.004 -.01	.23 (1, 60)	---	---	-.20					-.17				
Content Validity						.28	.06 .03	1.99 (2, 59)	.06	3.73 (1, 59)	.32*				
Performance Utility											-.07	.07 .02	1.45 (3, 58)	.01	.44 (1, 58)

* $p \leq 05$

The addition of performance utility to the regression model increased the proportion of variance explained .7%, a non-significant increase, indicating the data failed to support Hypothesis 8. The total variance accounted for by the regression model at this stage, with organizational commitment, content validity, and performance utility as predictors, reached 7% ($R^2 = .070$), also non-significant. However, with the addition of performance utility to the model the Beta value for content validity became significant ($\beta = .32$, $p \leq .05$) (see Table 10).

Hypothesis 9: Learning average on computer-based tests explains a significant proportion of the variance in performance ratings after the variance explained by organizational commitment, content validity, and performance utility has been accounted for.

The entry of learning average into the regression model increased the total variance explained by a non-significant 1.2% showing that Hypothesis 9 is not supported. The total variance accounted for by the regression model increased to 8.2% ($R^2 = .082$) with the addition of learning but did not approach significance. The only significant Beta value in the model was content validity ($\beta = .44$, $p \leq .05$). These findings are summarized in Table 11.

Hypothesis 10: Transfer design explains a significant proportion of the variance in performance ratings after the variance explained by organizational commitment, content validity, performance utility, and learning has been accounted for.

The results of the regression analysis indicated that transfer design increased the total variance 1.8%, a non-significant increase. Hypothesis 10 is therefore not supported. Total variance explained by the model increased to 10%

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 11: Results of the Hierarchical Regression of Learning, Transfer Design and Transfer Climate Variables On Performance

	Step 4					Step 5					Step 6				
Variable	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)	β	R^2 Adj R^2	F (df)	Δ R^2	F (df)
Organizational Commitment	-.22					-.22					-.18				
Content Validity	.33*					.44*					.44**				
Performance Utility	-.07					-.01					.03				
Learning	-.11	.08 .02	1.27 (4, 57)	.01	.75 (1, 57)	-.15					-.12				
Transfer Design						-.20	.10 .02	1.25 (5, 56)	.02	1.13 (1, 56)	-.06				
Pos. Personal Outcomes											.10				
Neg. Personal Outcomes											.10				
Sup. Sanctions											.39**				
Peer Support											.52**				
Sup. Support											-.03				
Change Resist.											.38**				
Opp To Use											-.21	.46 .33	3.47*** (12, 49)	.36	4.64*** (7, 49)

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

(R^2 = .010), but was still not significant. At step five in the regression, content validity remained the only variable with a significant Beta value (see Table 11).

Hypothesis 11: The set of transfer climate variables (supervisory support, opportunity to use training, peer support, change resistance, supervisor sanctions, positive personal outcomes, and negative personal outcomes) explain a significant proportion of the variance in performance after the variance explained by organizational commitment, content validity, performance utility, learning, and transfer design has been accounted for.

The data showed that, when entered as a set, the transfer climate variables increased the total variance explained by the model 36%, a significant gain ($p \leq .001$). The addition of the set of transfer climate variables in the final step of the regression increased total variance explained to 46% (R^2 = .46) producing a significant model ($F_{12,49} = 3.47$, $p \leq .001$). The data thus support Hypothesis 11 (see Table 11).

Examination of Beta values to determine which transfer climate coefficients were significant contributors to the explanation of the variance in performance ratings indicated four significant coefficients. As seen in Table 11, the coefficient for content validity was significant (β = .44, $p \leq .01$), as it had been for the three previous regression steps. In addition, supervisor sanctions (β = .38, $p \leq .01$), peer support (β = .52, $p \leq .001$), and change resistance (β = .38, $p \leq .01$) also emerged as significant predictors of performance ratings.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Figure 15 graphically summarizes the results of the hierarchical regression analysis. In general, the results for hypotheses 6 through 11 were mixed. Dashed lines indicate that organizational commitment did not explain a significant proportion of the variance in performance ratings (hypothesis 6). The addition of content validity to the model (hypothesis 7) produced an increase in explained variance that approached but did not reach statistical significance. The introduction of performance utility did not significantly

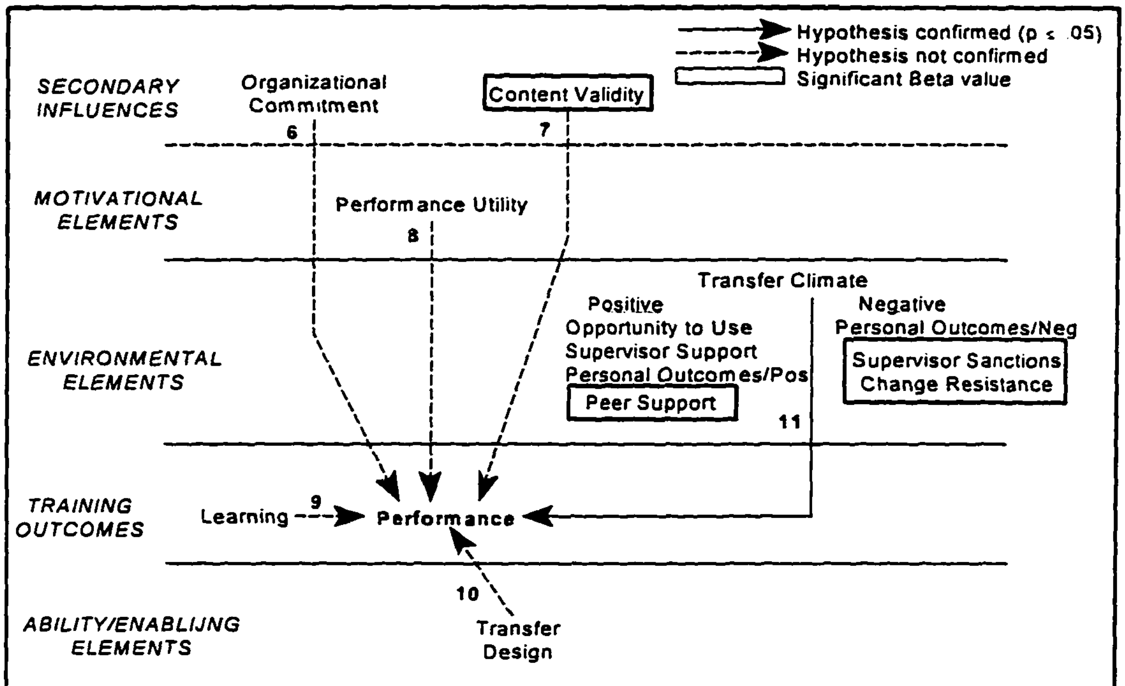


Figure 15: Summary of Hierarchical Regression Results

increase the proportion of variance explained beyond that explained by organizational commitment and content validity (hypothesis 8). However, the Beta coefficient for content validity became a significant predictor of performance in the model at this point and remained so throughout the final three steps of the hierarchical regression. The addition of learning to the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

regression model did not significantly increase the explained variance beyond that accounted for by organizational commitment, content validity, and performance utility combined (hypothesis 9) nor did the addition of transfer design (hypothesis 10). The variance in performance ratings accounted for by all of these variables taken together (10%) was not significant at the .05 level. However, with the addition of seven transfer climate variables to the regression model, the proportion of variance explained increased dramatically to 46%, making the model significant ($p < .001$). Examination of Beta coefficients showed that, of the seven transfer climate variables, three (peer support, change resistance, and supervisor sanctions) were significant contributors to the explanation of the variance in performance ratings.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER 5: SUMMARY AND DISCUSSION

This chapter briefly restates the research problem, describes the nature of the study, summarizes the hypotheses addressed and the corresponding findings, interprets those findings consistent with past research and theory, and makes recommendations for further research.

Restatement of the Research Problem

Present and future corporate survival is increasingly being determined by an organization's ability to effectively react and adapt to change (Hastings, 1994). Training is one key strategy many organizations are using in their efforts to adapt to ongoing change, meet performance demands, and realize organizational goals (Rummler & Brach, 1990). However, training is of little benefit unless what is learned is transferred to the job. Researchers have observed that there is often a dramatic discrepancy between what is learned in training and what is applied in the workplace (Baldwin & Ford, 1988; Noe, 1986). Such reports indicate that the absence of transfer is a major factor undermining training effectiveness.

The present level of knowledge with regard to the dynamics of the training transfer process is limited. To date, theory and research have provided little data about which factors play the greatest role in transfer or about how these factors effect transfer behavior under different conditions. The goal of the present research was to contribute to an understanding of the transfer of training process. This study examined the extent to which secondary influences on training effectiveness, motivational elements, environmental

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

elements, ability/enabling elements, and learning from computer-based training were associated with and explained the variance in the performance ratings of production operators performing critical procedures in a petrochemical manufacturing facility.

Summary of Findings

Bivariate correlation analysis was used to examine the relationships among variables including organizational commitment, training content validity, performance utility, learning, transfer design, transfer climate variables and performance ratings. These analyses indicated:

1. Secondary influences on training effectiveness (organizational commitment and content validity) were positively correlated with performance utility. As discussed earlier, performance utility was used in this study as a measure of transfer motivation.

2. Variations in scale scores on seven transfer climate variables were associated with changes in performance utility in the expected directions. Scores on the opportunity to use, peer support, supervisor support, and positive personal outcomes scales were positively correlated with performance utility. Scores on the negative personal outcomes, change resistance, and supervisor sanctions scales were negatively correlated with performance utility.

3. Learning from computer-based exams was not correlated with either performance utility or with performance ratings and was not a significant contributor to the explained variance in performance ratings.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

4. Correlation analysis of the associations between predictor variables and performance ratings yielded mixed results. Of the predicted correlates of performance, only two environmental elements, peer support and supervisor sanctions, were significant with medium range correlations ($r = .24$, $p \leq .05$ and $r = .35$, $p \leq .01$ respectively).

Hierarchical regression analysis was used to determine how the variance in performance ratings was partitioned among the predictor variables. This analysis indicated that content validity was a marginally significant predictor ($p \leq .06$) when entered at step two, increased in significance at step 3 ($p \leq .05$), and remained significant throughout the remaining regression steps. Only with the addition of the set of seven transfer climate variables to the regression equation did the variance explained by the model reach significant proportions ($R^2 = .46$, $p \leq .001$). In the full model, significant Beta values were found for content validity, supervisor sanctions, peer support, and change resistance.

Conclusions and Discussion

The results of this study make a number of contributions to an understanding of the transfer process. The following section interprets the research findings and discusses the potential contributions. The section is organized according to the conceptual model proposed for this study with conclusions discussed in terms of elements of the training transfer process including secondary, ability/enabling, training outcome, motivational, and environmental elements.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Secondary Elements

Although several researchers (Ameel, 1992; Clark et al., 1993; Hicks & Klimoski, 1987; Tannenbaum et al., 1991) have reported findings suggesting that the job-related relevance of training may be a key motivational factor in training effectiveness, training research has generally ignored this variable either as a pre-training factor in motivation to learn or as a training outcome factor affecting motivation to transfer. The findings of the present study affirm the importance of this variable by showing that training content validity was (a) positively and significantly correlated ($r = .53$, $p \leq .001$) with performance utility; (b) correlated to a lessor degree with performance ($r = .18$, $p \leq .08$); and (c) a significant predictor of performance ($\beta = .44$, $p \leq .001$) in a regression model.

The strong association between content validity and performance utility suggests that the job relevance of training content affects transfer motivation. Thus, high levels of training content validity are associated with high levels of perceived utility which some researchers (e.g., Noe, 1986) have suggested moderates the relationship between learning and behavior change and is therefore an integral part of motivation to transfer. This finding is consistent with both adult learning theory and expectancy theory perspectives which propose that increases in the perceived usefulness of training enhances training related motivation.

The results of the hierarchical regression analysis suggests that content validity is a training design variable that can directly influence performance. The conceptual model of transfer used in this study ordered variables in the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

logical sequence in which they would presumably occur in a typical training situation. Thus, perceptions of content validity occur prior to perceptions of performance utility. Hierarchical regression analysis provided some insight into the viability of this sequence. Ordinary least squares regression procedures applied to implicit sequences of mediated causal relationships suggests that causally "early" variables will predict causally "later" variables (Holton & Russell, 1996). Evidence for this is found when causally "later" variables are entered into the regression model and causally "early" variables become non-significant (James & Brett, 1984).

In the present case, for example, if the relationship between content validity and performance was mediated by performance utility then the Beta value for content validity would have become non-significant when performance utility entered the regression model. This, however, was not the case. Results showed that content validity approached significance when first entered (β = .28, $p \leq .06$), became significant (β = .32, $p \leq .05$) upon the entry of performance utility, and remained significant through the last step in the regression analysis (β = .44, $p \leq .01$). This finding implies that the relationship between content validity and performance is not totally mediated by performance utility and that content validity may have a direct relationship with performance.

In terms of the conceptual model used for this study, the results furnish evidence that content validity may be appropriate not only as a secondary

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

variable impacting performance through its motivational value but also as an ability/enabling variable influencing performance directly.

The findings with regard to content validity suggest that the relevance of KSAs taught in training to job performance is of fundamental importance for training transfer. Two important implications for training design emerge. First, training needs analysis conducted prior to the design of training provides the basis for establishing content validity through identification of the specific KSAs that control the performance component of interest (Campbell, 1988). Unfortunately, in practice, needs analysis do not always precede training design due to pressure to design and implement a program to met an urgent training need, lack of established procedures for conducting a needs analysis, or some other factor. In any case, only about a third of US companies conduct some type of a priori needs assessment to determine training and education needs (Saari et al., 1988). The critical role of relevant training content suggested by the present study supports a number of training researchers (Goldstein, 1986; Ostroff & Ford, 1989; Rothwell & Sredl, 1992; Sleezer, 1993; Swanson, 1994) who stress that a including a systematic training needs assessment process in training design is the most important step in establishing training effectiveness.

Second, in the absence of a needs analysis prior to training design or in the case of existing training courses whose content is based on a past, and possibly outdated, needs analysis, the present findings suggest the value of pre-training evaluations of training content. A number of techniques for assessing content relevance prior to training have been forwarded (e.g., Ford &

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Wroten, 1984; Goldstein, 1986; Wexley, 1984). Using techniques such as these would (a) verify the validity of training content a priori, a factor which could enhance trainee motivation; (b) increase training efficiency by allowing for content modifications where needed; and (c) facilitate training evaluation by establishing the job relevance of training so that the impact of other variables on training effectiveness could be better appraised.

Ability/Enabling Elements

The single ability/enabling element examined in this study was transfer design. Transfer design is a construct which refers to the extent training is designed to give trainees the ability to transfer learning to the workplace (Holton, 1996). Transfer design in the present study addressed trainee perceptions of the extent to which CATS training provided the skills necessary to transfer learning to the job. Research suggests that the addition of specific transfer design strategies such as goal setting (Reber & Wallin, 1984; Wexley & Nemeroff, 1975), self-management training (Gist et al., 1990), or relapse prevention training (Tziner et al, 1990) to training programs may positively influence performance outcomes.

Despite a mean rating for transfer design of 3.71 (see Table 5), indicating that trainees perceived the CBT to have some transfer design potential, the transfer design construct did not emerge as a significant contributor to the explanation of the variance in performance in this study. There are at least two possible explanations for this finding.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

First, when training involves learning and application of procedures, immediate hands-on practice is generally required. Immediate practice is considered a key element of adult learning (Knowles, 1990; Merriam & Caffarella, 1991; Tiemann & Markle, 1990) and, from a cognitive perspective, promotes transfer appropriate processing (Clark, 1992). In the present case, however, the CBT consisted largely of text-based presentations of technical procedures. Although the system did include some graphics and video, it did not present users with realistic or immediate opportunities for practice, critical thinking, or problem solving related to on-the-job use of procedures. Consequently, the design of the CBT in this study, by focusing on presentation of material and test scores as outcomes, failed to provide the kind of practice at the application level that is needed for transfer.

This is an issue that may have significant implications for the use of CBT in general. An important rationale for the use of CBT in many cases is its apparent cost effectiveness. For example, CBT can reduce overtime costs related to training by making training available during free times during the work day. Trainees can also control the amount of instruction they need, bypassing content with which they are proficient and focusing more specifically on their learning. This can lead to a significant savings in training time. The pace of instruction is also under learner control making adaptation to individual differences in learning rates more efficient.

However, when transfer design becomes a key issue in CBT, the cost savings potential of this technology may offer less of an impetus to adoption. If

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

application level understanding requires the use of video, graphics, or simulations, these design dimensions can dramatically increase the cost of CBT design, re-design, as well as the hardware and software needed to deliver this training. Thus, although CBT may offer an attractive and economical content delivery tool, the potential cost efficiency of this technology may be diminished when the organizational concern is for improved performance resulting from learning.

Another design dimension of the CBT that may have weakened the transfer potential of training was the individualized nature of the instruction. Subjects in the study voiced a preference for learning in small (2 to 4 person) groups because this was the workplace learning context to which they were accustomed. The individualized, text-based approach used in CATS (and implicit in much CBT), however, precluded the use of interactive oral explanation, summarizing, elaboration of material, and listening to others' explanations to check for accuracy, interactions inherent in small group learning which can enhance transfer appropriate processing (Hannafin, 1989). These kinds of interactions have been consistently found to be positively correlated with achievement and productivity gains (Carrier & Sales, 1987; Hythecker, Rocklin, Dansereau, Lambiotte, Larson, & O'Donnell, 1985; Webb, 1987) suggesting that in settings where teams or collaborative effort is emphasized, CBT designs which do not permit peer interaction may inhibit learning, retention, and subsequent transfer (Bates et al., 1996b).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Training Outcomes

A number of authors have suggested that the greater the degree of initial learning the more likely performance improvement will result (Gagne, 1970; Gick & Holyoak, 1987; Goldstein, 1986; Laker, 1990; Rouiller & Goldstein, 1993). The implication is that learning has a primary or direct influence on performance via trainees' acquisition of performance related knowledge. Some transfer research has confirmed this basic relationship (Noe & Schmitt, 1986; Tannenbaum et al., 1991; Xiao, 1995) whereas other research has not (Campion & Campion, 1987). These findings suggest that learning as a result of training is a necessary but not sufficient condition for performance improvement. In addition, findings such as those by Tannenbaum et al. (1991) which showed a positive correlation between post-training test performance and post-training motivation, suggest that learning outcomes may have a secondary or indirect impact on performance through their influence on motivation to transfer. The results of this study suggest neither a direct or indirect relationship between learning and performance. Data showed that learning was not correlated with performance utility or performance nor did it contribute significantly to the explained variance in performance.

The absence of significant results with respect to learning can be interpreted in several ways. First, it is probable that this finding is not due to the absence of content validity of the procedures included in the CBT. The procedures were written by the operators who performed them and there was

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

an established procedure for review and validation of the procedures once written. These two factors assured the procedures were accurate.

On the other hand, the findings with regard to learning may be partially a function of the range restriction inherent in the learning measure. As a certification prerequisite of the petrochemical firm studied, production operators had to attain a score of 80% or better on computer-based exams covering procedures for which they were responsible. The limited variability in learning scores that resulted may have contributed to the lack of significant results. It should be noted that a test criterion of 80% is typical of criterion referencing used in training and is a useful and acceptable design dimension.

Another possible explanation is that the findings are partially a function of measurement error due to invalid exams. Production operators often criticized the computer-based exams because their content was either irrelevant or of marginal importance to SOP performance. For example, a two item scale measuring the validity of CBT exams showed a mean of 3.47, indicating that trainees perceived the exams were only moderately valid. A common criticism was that exam questions were "too easy", suggesting they didn't adequately assess critical knowledge. Although operators passed the exams at the required level, it is therefore possible that they either gained insufficient knowledge or gained knowledge that had little motivational or performance outcome value.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

In summary, the findings of this study with regard to learning may have been a function measurement problems or content deficiencies of the CBT exams, both of which were beyond the control of the researcher.

Motivational Elements

Bivariate correlation analysis revealed relatively high correlations between performance utility and all of the predictor variables with the exception of learning. In fact, the correlations between performance utility and the other predictor variables were among the largest effects obtained in this study (see Appendix G). Adopting the conventions suggested by Cohen (1969), correlations in the range of 0 - .20 are considered small, .21 - .40 medium, and .41 and above large. Of the 10 variables correlated with performance utility, eight were categorized as large and two as medium. None of the correlations were considered small.

The interrelationship between performance utility and the correlates was predicted on the basis of previous research as well as theoretical grounds. For example, the significant correlation between organizational commitment and performance utility is congruent with research demonstrating relatively high correlations between commitment and behavioral intentions (Mathieu & Zajak, 1990; Steele & Ovalle, 1984). To the extent that scores on the performance utility scale reflect an intention to use training, and therefore motivation to transfer, then a positive association between organizational commitment and performance utility was predicted. This finding also corroborates research showing that when individuals intrinsically value organizational membership, as

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

the measure of commitment in this study reflects, a payoff in the form of increased work related motivation will result (DeCotiis & Summers, 1987; Mathieu & Zajak, 1990). In terms of training transfer, a strong positive correlation between organizational commitment and performance utility provides preliminary evidence that organizational commitment may be an important influence on training effectiveness to the extent it predisposes individuals to view training as useful and thus enhances motivation to transfer.

Expectancy theory (Vroom, 1964) predicts that individuals will be more motivated to learn and use training they perceive will lead to desirable performance related outcomes. Therefore variables which are perceived as facilitating attainment of performance related outcomes such as content validity, opportunity to use, peer support, positive personal outcomes, and supervisor support were predicted to be positively correlated with performance utility. Variables which are perceived as inhibiting attainment of performance related outcomes (i.e., negative personal outcomes, supervisor sanctions and change resistance) were expected to yield negative correlations. These relationships were confirmed by the correlational results.

This study hypothesized that, to the extent perceived utility is a key dimension of motivation to transfer, scores on the performance utility scale would reflect motivation to transfer. Performance utility was therefore expected to correlate positively with performance and to explain a significant proportion of the variance in performance ratings based on the rationale that trainees with higher levels of transfer motivation would perform better and receive higher

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

performance ratings. The data, however, showed that performance utility had no significant relationship with performance and did not account for a significant proportion of variance in performance.

There are several possible explanations for this result. First, an attempt was made in the present study to construct a valid comprehensive measure of motivation to transfer. When this proved unsuccessful, performance utility was adopted as a measure which addressed two dimensions of motivation to transfer, perceived usefulness and intent to use. The validity of the performance utility measure in this role is suggested by earlier research (e.g., see Hill et al., 1987; Huczynski & Lewis, 1980; Kanfer & Ackerman, 1989; Locke, 1968). However, it is possible that this is an incomplete measure of transfer motivation. For example, theories of motivation suggest that a motivation to transfer construct should address at least three key components: (a) Those which energize individuals to transfer training to the job, (b) those which direct transfer behavior, and (c) those which promote maintenance of that behavior (Steers & Porter, 1991). Failure to adequately assess all of these three components may have reduced the validity of the present measure.

Another possibility is that the level of transfer motivation among production operators was so low as to make its effect negligible. This may have resulted from the manner in which the CATS training was presented to employees. The CATS training had the potential to be an effective individual and organizational performance improvement tool through its' ability to provide just-in-time training updates on revised or new procedures, its' utility as an

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

information management tool and easily accessible reference tool, in addition to its' ability to help the organization to meet federal mandates and avoid costly fines. However, top management presented the training system to employees primarily as an expedient means to meet federal certification requirements. The potential for performance improvement associated with the use of the system or completion of CATS training was not articulated. Employees consequently viewed training as a requirement imposed on them by top management and the federal government, not as an opportunity to profit from a performance improvement innovation. As a result, positive pre-training attitudes and expectations that the training would enhance job performance were not fostered and the subsequent motivational value that these expectations would have engendered was absent.

This analysis suggests that the provision of appropriate pre-training information, such as that highlighting the performance improvement potential of training, may enhance transfer motivation and subsequent performance. Research has, in fact, shown that pre-training factors such as the provision of relevant pre-training information (Baldwin & Magjuka, 1991; Hoiberg & Berry, 1978), how the purpose of training was framed (Quinones, 1995), and organizational support for training (McFarlane, Shore, & Wayne, 1993) can significantly impact training outcomes through their influence on training related motivation. Research also suggests that other pre-training factors including negative pre-training events (Smith-Jentsch et al., 1996), choice to attend training (Hicks & Klimoski, 1987) or choice of training content (Tannenbaum et

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

al., 1991), supervisory expectations of trainee performance in training (Eden & Ravid, 1982; Eden & Shani, 1982), and training related self-efficacy (Eden & Kinnar, 1991) can also influence training effectiveness and, on that account, are deserving of pre-training attention.

In general, this research indicates that pre-training variables can impact the transfer process through their impact on trainee cognitive and motivational states. This, in turn, suggests the potential value to the transfer process of conducting a pre-training assessment of trainees' cognitive or motivational states. If such an assessment revealed inappropriate cognitions, motivational levels, or the presence of other obstacles to successful training transfer then a pre-training component could be designed and implemented to overcome these obstacles.

Environmental Elements

Transfer of training climate comprises a number of organizational and perceptual variables that reflect individual-organization interactions in the generalization and maintenance of training on the job. This study examined a revised conceptualization of transfer climate which included transfer climate variables that were perceived according to their referent or source in the work environment (e.g., supervisor, peer/task, or self). Seven transfer climate variables were examined consisting of negative personal outcomes, positive personal outcomes, opportunity to use, peer support, change resistance, supervisor support, and supervisor sanctions.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

As a set, the transfer climate variables were shown to account for a significant proportion ($R^2 = .36$, $p \leq .001$) of the variance in performance ratings. This finding corroborates other research (Baumgartel & Jeanpierre, 1972; Baumgartel et al., 1984; Rouiller & Goldstein, 1993) which has shown transfer climate variables as a set to be the single largest contributors to the prediction of training outcomes. In addition, this result, together with Rouiller and Goldstein's (1993) finding that transfer climate accounted for 48% of the variance in transfer behavior, suggests that previous estimates of climate's ability to account for the variance in training effectiveness may have been far too low. Noe (1986) proposed, for example, that motivation and climate together may account for no more than 15 to 20% of performance variance. The magnitude of the contribution of transfer climate to the prediction of performance in these two studies greatly exceeds that estimate.

Although a good deal has been written suggesting the value of criterion referenced measures of organizational climate for understanding work behavior (e.g., see Schneider, 1975; 1980; Schneider & Hall, 1972; Zohar, 1980), few studies have used a climate construct to examine factors influencing training effectiveness. The present findings place this study alongside less than a handful of other studies (e.g., Rouiller & Goldstein, 1993; Tracy et al., 1995) which have operationalized a transfer climate measure and verified the importance of climate in training transfer. This finding therefore makes an important contribution to the growing recognition that specific attributes of the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

organizational work environment, operationalized as transfer of training climate, are key factors influencing the training transfer and training effectiveness.

Interpersonal climate dimensions were among the most powerful predictors of performance in this study. Peer support, group resistance to change and supervisor sanctions all emerged as significant predictors of performance with Beta values of .52, .38, and .39 respectively ($p \leq .01$). Peer support and supervisor sanctions were also significantly correlated with performance ($r = .22$, $p \leq .05$ and $r = .31$, $p \leq .01$ respectively). It is clear from these results that work group members belief about themselves as a group, normative expectations about group members work behavior, and supportive interpersonal relationships were highly influential factors dictating the use of training on the job. These data (a) contradict some research (Russell et al., 1985; Peters et al., 1985) reporting no interaction between social support and training outcomes in field studies; (b) endorse suggestions that norms and interpersonal relations at the work group level can constrain or facilitate the performance of group members (Ameel, 1992; Baumgartel & Jeanpierre, 1972; Hand et al., 1973; Hastings et al., 1995; Noe et al., 1990); and (c) illustrate the vital role interpersonal elements can play in training transfer.

As noted earlier, change resistance emerged as a significant predictor of performance in this study. Change resistance is a group level construct which refers to the extent to which prevailing group norms are perceived by the trainee to resist or discourage the use of new skills. Resistance to change may result from perceptions that change is difficult or requires a level of work

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

intensity above the norm (Huczynski & Lewis, 1980). In the present setting, for example, production operators may have believed that performing SOPs as written in CATS would require additional or unnecessary steps over and above the methods typically used. Resistance to change therefore may have gained significance as a predictor as a result of operators' perceptions that extra effort was required in planning how and when to use the training, overcoming the inertia of doing things the "old way", or in actually applying what was learned. Bahn (1973) suggested that resistance to change may come about simply because changes are introduced from the outside. In the present case, training and certification requirements were a result of federal mandates and participation in training itself was a result of management directive. Work group perceptions that the training was imposed from above therefore may have also been a factor adding to the significance of change resistance.

Interestingly, the data showed a positive correlation between supervisor sanctions and performance ratings. Supervisor sanctions refers to the extent to which supervisors are indifferent to or actively oppose the use of training. A negative correlation with performance ratings was predicted based on the rationale that the greater a supervisor's indifference or opposition to training the less trainees would perceive the training as useful. As a consequence, levels of motivation to learn and transfer would be attenuated and performance levels would decrease. Although supervisor sanctions was shown to be negatively correlated with performance utility as predicted, the positive correlation with performance ratings is perplexing.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

There are at least two plausible explanations for this unexpected finding. First, the result could have been a function of measurement error. Since the performance measure in this study was based on supervisor ratings of subordinate job behavior, it is not unreasonable to expect that if a supervisor opposed or was indifferent to the use of training by subordinates, then job performance ratings of subordinates using training may be negatively affected. The mean scale score for supervisor sanctions was a moderate 2.55 indicating that operators perceived some supervisory opposition to training. It is therefore possible that rater bias may have been manifested in lower performance ratings for high performing training users.

An equally tenable interpretation is that supervisory opposition to use of training motivated operators to perform at higher levels. The procedures that went into CATS training were written by production operators who performed those procedures as a routine part of their jobs. Supervisors did not usually participate in writing the procedures, in part because, although intimately familiar with the production processes, they did not routinely perform specific procedures. It is reasonable to assume that, if operators wrote the procedures, they generally perceived the procedures taught in training to be correct and that the use of these procedures on the job would lead to safe and efficient job performance. Data from this study show, in fact, that the procedures were perceived as high in content validity and performance utility. These two dimensions are critical in the present setting because the procedures performed by operators were part of highly hazardous production process.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Inaccurate completion of procedures presented the potential for serious health and safety consequences. These considerations may have galvanized operator resistance to supervisor opposition, intensifying their focus on completing procedures correctly. Thus, operators working under sanctioning supervisors performed procedures correctly and received high (and accurate) ratings as a result.

In summary, it is unclear what produced the unexpected positive correlation between supervisor sanctions and performance ratings. Certainly the nature of the work culture and processes that were a part of this study could have created some unique dynamics. Further research is needed to clarify the relationship between these variables.

Supervisor support was not a significant predictor of training use in this study. This finding was not particularly surprising given the medley of previous research results on the value of supervisor support in training. For example, studies have shown supervisor support positively associated with successful transfer attempts (Huczynski & Lewis, 1980), performance ratings (Becker & Klimoski, 1989), self-reports of transfer behavior (Xiao, 1996), as well as a significant predictor of perceived training utility (Clark et al., 1993). Other research has shown that supervisory support behaviors contribute very little to training outcomes (Hastings et al., 1995; Gielen & VanderKlink, 1995; Russell et al., 1985). This mix of findings may be due, in part, to the use of a variety of unvalidated measures of supervisor support from study to study. Consequently, measurement error may be a contributing factor in the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

inconsistency of findings. It is also possible that, in practice, supervisors add little to the transfer of training either because their efforts to encourage transfer are too superficial to be effective (Gielen & VanderKlink, 1995), they know little about the training in question or how to support transfer (Preskill & Kusy, 1994), they have perceptions of support that do not correlate with those of the trainee, or because of some intervening variable such as supervisor-trainee affect.

The implication is that a functional understanding of supervisor support of training transfer has not yet been attained. Research has yet to describe when supervisory support will facilitate training transfer, when it will not, or why. Furthermore, although supervisor support is generally regarded as a multidimensional construct (Baldwin & Ford, 1988) only two dimensions (positive support behaviors and supervisor sanctions) have been operationalized and measured. Research is needed to test for and identify other core dimensions of supervisor support that are present across settings. Full specification of the dimensions of supervisory support will enable development of a valid and generalizable measure of this construct. Such a measure is a pre-requisite for an increased understanding of how supervisory support works with different kinds of training in different settings. It will also facilitate the development of appropriate interventions to provide supervisors with the tools they need to effectively support training transfer.

General Implications

Tannenbaum and Yukl (1992) noted that there is virtually no understanding of what constitutes an organizational transfer climate. Since that

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

observation, at least three researchers have operationalized a transfer climate construct in an effort to increase our understanding of the nature and impact of the organizational climate surrounding training transfer. Rouiller and Goldstein (1993), and subsequently Tracy et al. (1995), conceptualized transfer climate as composed of both situational cues and consequences. This structure suggested that individuals perceived transfer climate by type of psychological cues (e.g., goal cues, social cues, etc.).

The present study, however, supports a different conceptual structure for transfer climate. Here the transfer climate measure was constructed according to the perceived referent in the organization. In this conceptualization, individual transfer climate constructs are seen as a function of the source in the work environment that gave rise the particular perceptions (see Holton et al., 1996a). The present research strongly supported this conceptualization by showing that individual perceptions of supervisor opposition to training (supervisor sanctions), peer support, and work group resistance to change explained a significant proportion ($R^2 = .36$, $p \leq .001$) of the variance in performance ratings. Although this may not be the definitive factor structure for transfer climate, the implication is that transfer climate may be structured differently than had previously been thought. Future research should be directed at verifying the transfer climate structure identified in this study, the content of the transfer climate constructs, and assessing the generalizability of the constructs to other settings and populations.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

The results of this study showed that if an organization intends to use training as a performance improvement tool, then transfer climate cannot be ignored. This may be particularly true when the training initiative is the result of a mandate, either from top management or by legislative fiat. A potential for resistance to mandated training may exist either because the training is imposed without participation or consent of the trainees or trainees perceive that it does not address their needs or priorities. The negative training attitudes that may result from these factors make the presence of a positive transfer climate, such as one in which high levels of supervisory and peer support for the use of training are present, even more important. In addition, the potential for resistance to mandated training, together with the significance of work group variables shown in the present study, suggests that information provided by a pre-training transfer climate analysis directed at determining the feelings and perceptions of work group members about training could have enhanced training acceptance and effectiveness.

Bandura (1986) has argued that individuals act on the basis of what they think they can do as well as their beliefs about the outcomes of various actions. The latter component suggests that cognitive sources of motivation like valence and instrumentality can be useful concepts for understanding work behavior. Expectancy-valence theory (Vroom, 1964), for example, predicts individuals in the workplace hold effort-performance expectancies that result in motivation: When perceived outcome expectancy is high and outcomes are highly valued then motivation to perform will be greater. In the present study, the effect of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

training content validity on performance was interpreted from this perspective. Content validity was seen as affecting training related motivation via perceived utility and the related potential for fulfilling expectations of performance related learning.

Researchers have used expectancy-valence theory to suggest that individuals will not be motivated to perform unless they believe training will result in either improved job performance (Tannenbaum et al., 1991) or career advancement (Clark et al., 1993). However, the content and strength of interpersonal climate variables in this study suggest these conceptualizations of expectancy outcomes may be too restrictive. For example, peer behaviors supporting training, supervisory opposition to training application, and group resistance to change, may be understood as framing requirements for positive self-evaluations, creating opportunities for self-satisfaction, or of providing a sense of both work-related and interpersonal fulfillment (e.g., see Koppelman et al., 1990). A productive area for future research may be examination of these or similar interpersonal outcomes and the degree to which they contribute to an understanding training related motivation from an expectancy-valence perspective.

A new group level dimension of transfer climate, change resistance, emerged as a significant predictor of performance in this study. This construct is composed of items that suggest a normative group resistance or acceptance to introducing new learning from training. Change resistance has received very little research attention in the training literature although there are indications

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

that a transfer dimension of this nature may be of some value. A study of transfer reported by Hastings et al. (1995), for example, found that one environmental constraint to transfer was participants' belief that training would disrupt the functioning of current work groups. In addition, conceptually similar constructs such as openness to experience (Barrick & Mount, 1991) at the individual level and continuous learning culture (Tracy et al., 1995) at the organizational level have been shown to be valuable constructs in understanding knowledge acquisition and use. Together with the present findings, the indication is that a normative measure of openness or resistance to change may be an important factor in understanding transfer of training climate.

The findings of this study also suggest that the influence of system factors on job-relevant behavior can be positive as well as negative. System factors refer to broad variety of situational influences on performance including such things as training, reward systems, work group support, equipment, work load, and so on. Although several authors have recognized that system factors can affect performance (Peters et al., 1985; Bernardin, 1989; Blumberg & Pringle, 1982), these factors are generally viewed negatively, primarily as constraints on individual ability or motivation whose effect is to inhibit performance. The significance of peer group support in this study supports alternative conceptualizations of the role of system factors (e.g., Cardy & Dobbins, 1994) and other findings (e.g., Baumgartel & Jeanpierre, 1972; Cohen, 1990; Hastings et al., 1995; Olson & Borman, 1989; Xiao, 1995) which

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

suggest that system factors can also positively influence employee motivation and performance.

As discussed in an earlier section, research (Harris & Schaubroeck, 1988; Kraiger, 1986) suggests that self-reports may be inadequate criterion measures of performance. A significant criticism of studies of training transfer prior to 1988 has been their nearly singular use of self-reports as outcome measures (Baldwin & Ford, 1986). The review of more recent research conducted for this study found that self-reports have continued to be the foremost criterion measure in training research. An important strength of the present study was therefore the use of supervisor ratings of job performance as the criterion measure. The performance rating instruments used here were the product of an elaborate development process which identified of a subset of critical tasks, ascertained which of these tasks supervisors most frequently observed operators performing, and led to the collection of supervisory judgements of the percentage of time these critical tasks were done correctly. This painstaking process helped insure the content validity of the rating instrument.

Study Limitations

There are several potential limiting factors with regard to the findings of the present study. First, the cross-sectional nature of the data indicates that causal relationships between variables can only be inferred. Because the study was ex post facto, there were no base line measurements of either learning or performance. It was therefore impossible to determine if there was any change

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

as a result of training. The lack of experimental control inherent in field studies makes it difficult to isolate the effects of variables of interest. For example, the Hawthorne effect (Campbell & Stanley, 1963) may have influenced results to the extent that respondents were influenced by social desirability factors as they completed the surveys. The data collection procedures for this study extended over a relatively long period of time introducing the possibility that unknown events could have unexpectedly influenced the results. Variables other than those analyzed in the present study may have also had a significant influence on training transfer. For example, variables that affect transfer motivation such as job attitudes (e.g., internal work motivation or job involvement), personality characteristics such as locus of control or self-efficacy, and intervention readiness (Holton, 1996) were not included in this study. Cognitive ability was not included as an ability/enabling variable although it has been suggested (Noe & Schmitt, 1986) that ability may account for as much as 16% of the variance in performance. Future research should systematically examine the role of these variables in training related motivation and transfer.

Another potential limitation of this study was that the generalizability of the results may be restricted by the characteristics of the sample. It is possible that production operators in petrochemical plants have unique attitudes that limit the generalizability to other individuals employed in similar settings.

Self-report questionnaires were the only source of data in this study for the independent variables with the exception of learning. Method bias resulting

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

from the use of survey/questionnaire instruments has been cited as a cause of inflated correlations (Mathieu & Zajac, 1991). It is therefore possible that the magnitude of interrelationships observed between performance utility and the other independent variables in this study may have been partly a function of method bias. On the other hand, some research indicates that method bias is not as serious a problem as has been assumed (Spector, 1987) and that the seriousness of method bias depends on the research question. For instance, when perceptions are the object of empirical interest, as they were in this study, method bias may not be a serious issue (Clark et al, 1993). Thus, although it is not expected that method bias significantly affected the pattern of findings in this study, additional sources of data would have strengthened the validity of self-report data for the independent variables. Future investigations into the transfer of training process would benefit from the use of multiple sources of data.

In sum, although a number of limitations have been identified which could have potentially limited the results of this research, it is not believed that they significantly undermined the validity of the findings and implications.

Future Research

The results of this study provided evidence that transfer climate can be viewed as a set of work environment facilitators and constraints capable of significantly affecting transfer and performance. This conclusion suggests the potential value of assessing a range of training related factors during a systematic needs analysis process. Such an analysis would carefully examine

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

the transfer environment, identify facilitators and inhibitors, and provide information that could be used to modify the pre- or post-training environment to support transfer. Research is needed to develop a multidimensional assessment tool to fully assess the transfer environment surrounding training. This instrument should provide information about organizational level factors such as transfer climate variables, training design factors including content validity and transfer design, pertinent trainee characteristics such as training related expectations, motivation to learn, motivation to transfer, and training related self-efficacy. Used a priori, such a tool could provide valuable information about the performance outcome potential of training interventions by identifying barriers and supports in the work environment. This information would also suggest possible pre-training interventions to enhance training effectiveness. Used following training, it would provide evaluative information about the causes of training success or failure and point to beneficial future interventions to enhance training effectiveness. Over time, data from this instrument could contribute to the development of a taxonomy of factors or circumstances that inhibit or facilitate training transfer in different settings.

In this context, Holton (1996) has argued that the dominant training evaluation model in use today, the four level evaluation model (see Kirkpatrick, 1976; 1994), is not comprehensive in nature and therefore ignores the myriad intervening variables in the training process. Because evaluations based on such a model focus on factors related to the training program itself, they may fail to identify the true causes of training failure. The present research, for

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

example, suggests that variables outside the training program, specifically peer support, change resistance, and supervisor sanctions can have a significant impact on training effectiveness. Had variables such as these, which are extraneous to the training program, not been examined the only conclusion that would have been possible, given inadequate performance levels as a result of training, was that something was wrong with the training program. The implication is that understanding the complexity of influences on training effectiveness, which are typical of workplace training, requires a comprehensive model of training effectiveness, one that is rich enough to account for the system-wide factors which may influence training outcomes.

The present study thus provides partial support for a conceptual model based on Holton's (1996) comprehensive training evaluation and measurement model. This and other research (e.g., Alliger & Janak, 1989; Noe & Schmitt, 1986; Mathieu et al., 1992) strongly suggest that only through the use of comprehensive, integrated models of the training process can the cause and effect of training success or failure be reliably identified. Holton's (1996) model offers a good starting point for model development. His model parsimoniously integrates what is known about training effectiveness and puts it in the form of a testable model which has promising research potential and practical application. The strength of the model is its' basis in previous empirical research, integration within an existing theoretical framework, and systems approach to the study of training effectiveness. The model provides a framework in which training inputs, processes, outputs, and environmental

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

connections and interactions can be examined and results interpreted. It implicitly emphasizes the value of accounting for as many potentially critical variables in the training process as is possible, a particularly important approach when studying training effectiveness because it is difficult to know in advance the relative importance of variables in different settings. Research is needed to validate the specific components of this model, identify and operationalize the critical variables in each component of the model, and test the hypothesized relationships proposed in the model (Holton, 1996).

Although the present study made valuable contributions to an understanding of training transfer and provided useful information for deriving causal hypotheses, future studies of training transfer should aim toward a diversification of research methods directed at gaining an understanding of the causal processes related to training transfer. For example, testing models of training effectiveness with large samples would allow use of more sophisticated statistical techniques (e.g., Structural Equation Modeling) which can evaluate all proposed causal relationships in a model simultaneously (Holton, 1996). Longitudinal studies would provide useful information about how training transfer is maintained over time (see Baldwin & Ford, 1988). To the extent that primary and secondary antecedents to training transfer can be manipulated and evaluated in quasi-experimental designs, greater confidence in the validity of hypothesized causal relationships can be developed. Finally, diverse research methodologies support efforts toward coherent model and theory building

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

(Mathieu & Hamel, 1989) as well as the development of interventions aimed at managing training transfer.

The findings of this study imply that one potential shortcoming of CBT as a performance improvement tool is that design dimensions necessary for supporting training transfer may, in some cases, be absent. In the present case, as in many applications of computer-based training, the focus was on content delivery. To facilitate application level understanding a one-on-one training component was planned as a supplement to the CBT. This complementary training component supported transfer by allowing trainees an opportunity to use their training under work conditions in the presence of more knowledgeable peers or supervisors who provided coaching when necessary.

The implication is that the simple transfer of classroom instruction to the computer, despite the potential for increased instructional efficiency, does not necessarily imply that improvements in job performance will result. It is possible, for example, that the technological (e.g., screen-based instruction) or instructional (e.g., implicit need for self-directed learning) dynamics of CBT make application level learning more difficult. This raises the question of whether the use of computer-based instruction actually complicates the transfer problem.

Unfortunately, little if any research has been directed at understanding how or if CBT can foster performance improvement through the workplace application of learning. Even the relatively extensive research done with commercial and military simulation systems has not provided much relevant

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

transfer information relative to CBT. The major focus of much of this research has been on the measurement of performance in the simulation and the degree of fidelity needed to validly measure trainee performance rather than on transfer of training using computer-based simulations (Baudhuin, 1987). In addition, virtually no research has assessed the transfer value of a variety of advanced CBT design options such as hypertext, graphics, animation, interactive videodisc instruction, the use of cooperative dialogue, or cognitive engagement strategies including the use of queries, real-time responding, and the use of predictions and hypothesizing (see Hannafin, 1989). In sum, there is a need (a) for research aimed at assessing the transfer potential of CBT versus other kinds of training; and (b) to extend the goals of both computer-based instruction and research beyond learning outcomes to the identification and integration of transfer design elements which facilitate both learning <u>and</u> transfer in the workplace.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

REFERENCES

Adams, J. A. (1987). Historical review and appraisal of research on the learning, retention, and transfer of human motor skills. Psychological Bulletin, 101, 41-74.

Alliger, G. M., & Janak, E. A. (1989). Kirkpatrick's levels of training criteria: Thirty years later. Personnel Psychology, 42, 331-342.

Ameel, L. J. (1992). Transfer of training for a basic sales skills training program. Unpublished doctoral dissertation. United States International University, School of Human Behavior.

Anderson, J. R. (1987). Skill acquisition: Compilation of work-method problem solutions. Psychological Review, 94, 192-210.

Andrisani, P. J., & Nestel, G. (1976). Internal-External control as a contributor to and outcome of work experience. Journal of Applied Psychology, 61(2), 156-165.

Annette, J., & Sparrow, J. (1985). Transfer of training: A review and practical implications. Programmed Learning and Educational Technology, 22, 116-124.

Bahn, C. (1973). The counter training problem. Personnel Journal, 1068-1072.

Baldwin, T. T. (1992). Effects of alternative modeling strategies on outcomes of interpersonal-skills training. Journal of Applied Psychology, 77(2), 147-154.

Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. Personnel Psychology, 41(1), 63-105.

Baldwin, T. T., & Magjuka, R. J. (1991). Organizational training and signals of importance: Effects of pre-training perceptions on intentions to transfer. Human Resource Development Quarterly, 2, 25-36.

Baldwin, T. T., Magjuka, R. J., & Loher, B. T. (1991). The perils of participation: Effects of choice of training on trainee motivation and learning. Personnel Psychology, 44, 51-65.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Bandura, A. (1977). Social learning theory. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122-147.

Bandura, A. (1986). Social foundations of thought and action. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1991). Social cognitive theory of self-regulation. Organizational Behavior and Human Decision Processes, 50, 248-287.

Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. Personnel Psychology, 44, 1-26.

Bar-Tal, D, & Bar-Zohar, Y. (1977). The relationship between perception of locus of control and academic achievement. Contemporary Educational Psychology, 2, 181-199.

Bass, B. M., & Vaughn, J. A. (1966). Training in industry: The management of learning. Belmont, CA: Wadsworth.

Bates, R. A., Holton, E. F. III, & Seyler, D. (1996a). Validation of a transfer climate instrument. In E. F. Holton III (Ed.), Academy of Human Resource Development 1996 Conference Proceedings (pp. 426-433).

Bates, R. A., Holton, E. F. III, & Seyler, D. (1996b). Principles of CBT design and the adult learner: The need for further research. Performance Improvement Quarterly, 9(2), 3-24.

Baudhuin, E. S. (1987). The design of industrial and flight simulators. In S. M. Cormier & J. D. Hagman, Transfer of Learning (pp. 217-237). San Diego, CA: Academic Press.

Baumgartel, H.,& Jeanpierre, F. (1972). Applying new knowledge in the back home setting: A study of Indian managers' adoptive efforts. Journal of Applied Behavioral Science, 8, 674-695.

Baumgartel, H., Reynolds, M. J. I., & Pathan, R. Z. (1984). How personality and organizational climate variables moderate the effectiveness of management development programs: A review and some recent research findings. Management and Labour Studies, 9(1), 1-16.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Baumgartel, H., Sullivan, G. J., & Dunn, L. E. (1978). How organizational climate and personality affect the payoff from advanced management training. Kansas Business Review, 5, 1-10.

Beaudin, B. P. (1987). Enhancing the transfer of job-related learning from the learning environment to the workplace. Performance & Instruction, 26(10), 19-21.

Becker, T. E., & Klimoski, R. J. (1989). A field study of the relationship between the organizational feedback environment and performance. Personnel Psychology, 42, 343-358.

Belsley, D. A., Kuh, E., Welsch, R. E. (1980). Regression diagnostics: Identifying influential data and sources of colinearity. New York: Wiley.

Berkowitz, L., & Donnerstein, E. (1982). External validity is more than skin deep: Some answers to criticisms of laboratory experiments. American Psychologist, 37, 245-257.

Bernardin, H. J. (1989). Increasing the accuracy of performance measurement: A proposed solution to erroneous attributions. Human Resource Planning, 12, 239-250.

Blumberg, M., & Pringle, C. D. (1982). The missing opportunity in organizational research: Some implications for a theory of work performance. Academy of Management Review, 7, 560-569.

Brinkerhoff, R. O. (1987). Achieving results from training. San Francisco: Jossey-Bass.

Brinkerhoff, R. O., & Gill, J. S. (1992). Managing the total quality of training. Human Resource Development Quarterly, 3(2), 121-131.

Broad, M. L. (1982). Management actions to support transfer of training. Training and Development Journal, 5, 124-130.

Broad, M. L., & Newstrom, J. W. (1992). Transfer of training. Reading, MA: Addison-Wesley Publishing Company.

Brooks, L. W., & Dansereau, D. F. (1987). Transfer of information: An instructional perspective. In S. M. Cormier & J. D. Hagman (Eds.), Transfer of learning: Contemporary research and applications (pp. 121-150). New York: Academic Press, Inc.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Burke, M. J., & Day, R. R. (1986). A cumulative study of the effectiveness of managerial training. Journal of Applied Psychology, 71, 232-245.

Burnaska, R. F. (1976). The effects of behavior modeling training on managers' behaviors and employees' perceptions. Personnel Psychology, 29, 345-349.

Butterfield, E. C., & Nelson, G. D. (1989). Theory and practice of teaching for transfer. Educational Technology Research and Development, 37, 5-38.

Campbell, D. T. (1988). Training design for performance improvement. In J. P. Campbell & R. J. Campbell (Eds.), Productivity in Organizations, (pp.417-430). San Francisco: Jossey-Bass.

Campbell, J. P., Dunnette, M. D., Lawler, E. E., & Weick, K. E. (1970). Managerial behavior, performance, and effectiveness. New York: McGraw-Hill.

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Boston: Houghton Mifflin Co.

Campion, M. A., & Campion, J. E. (1987). Evaluation of an interviewee skills training program in a natural field experiment. Personnel Psychology, 40, 677-691.

Cardy, R. L., & Dobbins, G. H. (1994). Performance appraisal: Alternative perspectives. Cincinnati, OH: South-Western Publishing Co.

Carrier, C. A., & Sales, G. C. (1987). Pair versus individual work on the acquisition of concepts in a computer-based instructional lesson. Journal of Computer-Based Instruction, 14(1), 11-17.

Clark, R. C. (1992). Computer-mediated instruction. In H. D. Stolovitch & E. J. Keeps (Eds.), Handbook of human performance technology (pp. 449-473). San Francisco: Jossey-Bass.

Clark, C. S., Dobbins, G. H., & Ladd, R. T. (1993). Exploratory field study of training motivation: Influence of involvement, credibility, and transfer climate. Group and Organization Management, 18(3), 292-307.

Cohen, D. J. (1990). What motivates trainees. Training and Development Journal, 11, 91-93.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Cohen, J. (1969). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences. Hillsdale, NJ: Erlbaum.

Cormier, S. M. (1987). The structural processes underlying transfer of training. In S. M. Cormier & J. D. Hagman (Eds.), Transfer of learning: Contemporary research and applications (pp. 152-181). San Diego, CA: Academic Press.

Cormier, S. M., & Hagman, J. D. (1987). Transfer of learning: Contemporary research and applications. San Diego, CA: Academic Press.

Craig, R. (1987). Training and development handbook (3rd ed.). New York: McGraw-Hill.

Darlington, R. B. (1990). Regression and linear models. New York: McGraw-Hill Publishing Company.

Day, D. V., & Silverman, S. B. (1989). Personality and job performance: Evidence of incremental validity. Personnel Psychology, 42, 25-36.

Deci, E. L., Connell, J. P., Ryan, R. M. (1989). Self-determination in a work organization. Journal of Applied Psychology, 74(4), 580-590.

Decker, P. J. (1980). Effects of symbolic coding and rehearsal in behavior-modeling training. Journal of Applied Psychology, 65(6), 627-634.

Decker, P. J. (1982). The enhancement of behavior modeling training of supervisory skills by the inclusion of retention processes. Personnel Psychology, 35, 323-332.

Decker, P. J. (1983). The effects of rehearsal group size and video feedback on behavior modeling training. Personnel Psychology, 36, 763-773.

DeCotiis, T. A., & Summers, T. P. (1987). A path-analysis of a model of the antecedents and consequences of organizational commitment. Human Relations, 40, 445-470.

DeVellis, R. F. (1991). Scale development: Theory and applications. (Applied social research methods series, vol. 26). Newbury Park, CA: Sage.

Eden, D., & Kinnar, J. (1991). Modeling Galatea: Boosting self-efficacy to increase volunteering. Journal of Applied Psychology, 76(6), 77-780.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Eden, D., & Ravid, G. (1982). Pygmalion versus self-expectancy: Effects of instructor- and self-expectancy on trainee performance. Organizational Behavior and Human Performance, 30, 351-364.

Eden, D., & Shani, A. (1982). Pygmalion goes to boot camp: Expectancy, leadership, and trainee performance. Journal of Applied Psychology, 67, 194-199.

Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. Journal of Applied Psychology, 71(3), 500-507.

Feldman, D. C. (1989). Socialization, resocialization, and training: Reframing the research agenda. In I. L. Goldstein (Ed.), Training and development in organizations (pp. 376-416).

Fleishman, E. A. (1955). Leadership climate, human relations training, and supervisory behavior. Personnel Psychology, 6, 205-222.

Fleishman, E. A. (1972). On the relation between abilities, learning, and human performance. American Psychologist, 1017-1032.

Fleishman, E. A., Mumford, M. D. (1989a). The ability requirements scales. In S. Gael (Ed.), The job-analysis handbook for business, government, and industry. New York: Wiley.

Fleishman, E. A., Mumford, M. D. (1989b). Individual attributes and training performance. In I. L. Goldstein (Ed.), Training and development in organizations (183-255). San Francisco: Jossey-Bass.

Ford, J. K. (1994). Defining transfer: The meaning is in the answers. Adult Learning, 5(4), 23-30.

Ford, J. K., Quinones, M., Sego, D., & Sorra, J. (1992). Factors affecting the opportunity to use trained skills on the job. Personnel Psychology, 45, 511-527.

Ford, J. K., & Wroten, S. P. (1984). Introducing new methods for conducting training evaluation and for linking training evaluation to program redesign. Personnel Psychology, 37, 651-666.

Frayne, C. A., & Latham, G. P. (1987). Application of social learning theory to employee self-management of attendance. Journal of Applied Psychology, 72(3), 387-392.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Gagne, R. M. (1962). Military training and principles of learning. American Psychologist, 17, 83-91.

Gagne, R. M. (1970). The conditions of learning. New York: Holt, Rinehart, & Winston.

Gagne, R. M. (1985). The conditions of learning and theory of instruction (4th ed.). New York: Holt, Rinehart, and Winston.

Garavaglia, P. L. (1993). How to ensure transfer of training. Training and Development, 63-68.

Geroy, G. D., & Penna, C. J. (1995). Factors in the organizational climate that motivate the trainee to transfer behavior learned in a training setting to the actual work environment. In E. F. Holton (Ed.), Proceedings of the 1995 Academy of Human Resource Development Annual Meeting, 20-3.

Gick, M. L., & Holyoak, K. J. (1987). The cognitive basis of knowledge transfer. In S. M. Cormier and J. D. Hagman (Eds.), Transfer of Learning: Contemporary research and applications (pp. 9-47). New York: Academic Press.

Gielen, E. W. M. (1995). Transfer of training in a corporate setting. Unpublished doctoral dissertation, University of Twente, The Netherlands.

Gielen, E. W. M., & Van der Klink, M. R. (1995). Supervisory support as a transfer enhancing activity: Synthesis of four research projects. In E. F. Holton (Ed.), Proceedings of the 1995 Academy of Human Resource Development Annual Meeting, 20-1.

Gist, M. E. (1986). The effects of self-efficacy on training task performance. Academy of Management Best Paper Proceedings: 1986, 250-254.

Gist, M. E. (1987). Self-efficacy: Implications for organizational behavior and human resource management. Academy of Management Review, 12(3), 472-485.

Gist, M. E., & Mitchell, T. R. (1992). Self-efficacy: A theoretical analysis of its determinants and malleability. Academy of Management Review, 17, 183-211.

Gist, M. E., Bavetta, A. G., & Stevens, C. K. (1990). Transfer training method: Its influence on skill generalization, skill repetition, and performance level. Personnel Psychology, 43, 501-523.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Gist, M. E., Schwoerer, C., & Rosen, G. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. Journal of Applied Psychology, 74(6), 884-891.

Glick, W. H. (1985). Conceptualizing and measuring organizational and psychological climate pitfalls in multilevel research. Academy of Management Review, 10(3), 601-616.

Goldstein, I. L. (1980). Training in work organizations. Annual Review of Psychology, 31, 229-272.

Goldstein, I. L. (1986). Training in organizations: Program development, needs assessment, and evaluation. Pacific Grove, CA: Brooks/Cole.

Goldstein, I. L. (1989). Training and development in organizations. San Francisco: Jossey-Bass.

Goldstein, I. L., & Musicante, G. R. (1986). The applicability of a training transfer model to issues concerning rater training. In E. A. Locke (Ed.), Generalizing from laboratory to field settings (pp. 83-98). Lexington, Mass: Lexington Books.

Hackman, J. R., & Lawler, E. E., III (1971). Employee reactions to job characteristics. Journal of Applied Psychology, 55, 259-286.

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. Organizational Behavior and Human Performance, 16, 250-279.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). Multi variate data analysis (4th ed.). Englewood Cliffs, NJ: Prentice Hall.

Hand, H. H., Richards, M. D., & Slocum, J. W. (1973). Organizational climate and the effectiveness of a human relations training program. Academy of Management Journal, 16(2), 185-195.

Hannafin, M. J. (1989). Interaction strategies and emerging instructional technologies: Psychological perspectives. Canadian Journal of Educational Communication, 18(3), 167-179.

Harris, M. M., & Schaubroeck, J. (1988). A meta-analysis of self-supervisor, self-peer, and peer-supervisor ratings. Personnel Psychology, 41, 43-62.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hastings, S. L. (1994). Transfer of training: The impact of supervisory support, supervisory involvement, situational constraints, and self-efficacy on the application of technical skills training. Unpublished doctoral dissertation, University of Connecticut.

Hastings, S. L., Sheckley, B. G., & Nichols, A. B. (1995). Transfer of training: The impact of supervisory support, supervisory involvement, situational constraints, and self-efficacy on the application of technical skills training. In E. F. Holton (Ed.), Proceedings of the 1995 Academy of Human Resource Development Annual Meeting, 20-2.

Herold, D. M., & Parsons, C. K. (1985). Assessing the feedback environment in work organizations: Development of the job feedback survey. Journal of Applied Psychology, 70, 290-305.

Hicks, W. D., & Klimoski, R. J. (1987). Entry into training programs and its effects on training outcomes: A field experiment. Academy of Management Journal, 30(3), 542-552.

Hill, T., Smith, N. D., & Mann, M. F. (1987). Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. Academy of Management Journal, 39(3), 542-552.

Hocking, R. R. (1976). The analysis and selection of variables in a linear regression. Biometrics, 32, 1-50.

Hoiberg, A., & Berry, N. W. (1978). Expectations and perceptions of navy life. Organizational Behavior and Human Performance, 21, 130-145.

Holding, D. H. (1965). Principles of training. London: Pergamon Press.

Holding, D. H. (1991). Transfer of training. In J. E. Morrison (Ed.), Training for Performance: Principles of Applied Learning, (pp. 93-125). New York: John Wiley and Sons.

Hollenbeck, J. R., & Brief, A. P. (1987). The effects of individual differences and goal origin on goals setting and performance. Organizational Behavior and Human Decision Processes, 40, 392-414.

Holton, E. F. (1996). The flawed four-level evaluation model. Human Resource Development Quarterly, 1(7), 5-21.

Holton, E. F., Bates, R. A., Seyler, D. L. (1996a). Construct validation of a transfer climate instrument. Manuscript submitted for publication. Louisiana State University.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Holton, E. F., Seyler, D. L., & Bates, R. A. (1996b). Evaluation of a computer-based training system for OSHA Safety and Plant Operator Training (Technical Report). Baton Rouge, Louisiana: Louisiana State University, School of Vocational Education.

Holton, E. F., & Russell, C. J. (1996). A longitudinal examination of socialization readiness, processes, outcomes, and turnover. Manuscript submitted for publication. Louisiana State University.

Holyoak, K. H., & Koh, K. (1987). Surface and structural similarity in analogical transfer. Memory & Cognition, 15(4), 332-340.

House, R. (1968). Leadership training: Some dysfunctional consequences. Administrative Science Quarterly, 12, 556-571.

Howell, W. C., & Dipboye, R. L. (1986). Essentials of industrial and organizational psychology (3rd ed.). Chicago, IL: The Dorsey Press.

Howell, W. C., & Cooke, N. J. (1989). Training the human information processor: A review of cognitive models. In I. L. Goldstein (Ed.), Training and Development in Organizations (pp.121-182). San Francisco, CA: Jossey-Bass.

Huczynski, A. A., & Lewis, J. W. (1980). An empirical study into the learning transfer process in management training. The Journal of Management Studies, 17(2), 227-240.

Hunter, J. E. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. Journal of Vocational Behavior, 29, 340-362.

Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternative predictors of job performance. Psychological Bulletin, 96, 72-98.

Hythecker, V. I., Rocklin, T. R., Dansereau, D. F., Lambiotte, J. G., Larson, C. O., & O'Donnel, A. M. (1985). A computer-based learning strategy training module: Development and evaluation. Journal of Educational Computing Research, 1, 275-283.

Ilgen, D. R., Fisher, C. D, & Taylor, M. S. (1979). Consequences of individual feedback on behavior in organizations. Journal of Applied Psychology, 64(4), 349-371.

Ilgen, D. R., Nebeker, D. M., & Pritchard, R. D. (1981). Individual motivation and performance: Cognitive influences on effort and choices. In J. P. Campbell & R. J. Campbell (Eds.), Productivity in Organizations, (pp. 143-176). San Francisco: Jossey-Bass.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

James, L., & Brett, J. (1984). Mediators, moderators, and tests for mediation. Journal of Applied Psychology, 69, 307-321.

Jones, A. P., & James, L. R. (1979). Psychological climate: Dimensions and relationships of individual and aggregated work environment perceptions. Organizational Behavior and Human Performance, 23, 210-250.

Joyce, W. F., Slocum, J. W., & Von Glinow, M. A. (1982). Person-situation interaction: Competing models of fit. Journal of Occupational Behavior, 265-280.

Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. Journal of Applied Psychology, 74(4), 657-690.

Katz, D., & Kahn, R. L. (1978). The social psychology of organizations (2nd ed.). New York: Wiley.

Kelly, H. B. (1982). A primer on transfer of training. Training and Development Journal, 11, 102-106.

Kirkpatrick, D. L. (1967). Evaluation of training. In R. L. Craig & L. R. Bittel (Eds.), Training and Development Handbook (pp. 87-112). American Society for Training and Development, New York: McGraw-Hill.

Kirkpatrick, D. L. (1987). Evaluation of training. In R. L. Craig (Ed.), Training and development handbook: A guide to human resource development (3rd ed., pp. 301-319). New York: McGraw-Hill.

Kirkpatrick, D. L. (1994). Evaluating training programs: The four levels. San Francisco: Berrett-Koehler.

Knowles, M. (1980). The modern practice of adult education: From pedagogy to andragogy. (2nd ed.). New York, NY: Cambridge Books.

Knowles, M. (1990). The adult learner: A neglected species (4th ed.) Houston: Gulf Publishing Company.

Koch, J. T., & Steers, R. M. (1978). Job attachment, satisfaction, and trunover among public sector employees. Journal of Vocational Behavior 12, 119-128.

Koppelman, R. E., Brief, A. P., & Guzzo, R. A. (1990). The role of climate and culture in productivity. In B. Schneider (Ed.), Organizational culture and climate (pp. 282-318). San Francisco: Jossey-Bass.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Kozlowski, S. W., & Hults, B. M. (1987). An exploration of climates for technical updating and performance. Personnel Psychology, 40, 539-563.

Kraiger, K. (1986). Self, peer, and supervisory ratings of performance: So what? Paper presented at the First Annual Conference of the Society of Industrial/Organizational Psychology, Chicago, IL.

Kren, L. (1992). The moderating effects of locus of control on performance incentives and participation. Human Relations, 45(9), 991-1012.

Laker, D. R., (1990). Dual dimensionality of training transfer. Human Resource Development Quarterly, 1(3), 209-223.

Lakewood Research, (1995). Industry report. Training, 32(10), 29-74.

Latham, G. P., & Frayne, C. A. (1989). Self-management training for increasing job attendance: A follow-up and replication. Journal of Applied Psychology, 74(3), 411-416.

Latham, G. P., & Saari, L. M. (1979). Application of social learning theory to training supervisors through behavioral modeling. Journal of Applied Psychology, 64(3), 239-246.

Larson, E. W., & Fukami, C. V. (1984). Relationships between worker behavior and commitment to the organization and union. Academy of Management Proceedings, 34, 222-226.

Locke, E. A. (1968). Toward a theory of task motivation in organizations. Organizational Behavior and Human Performance, 3, 157-189.

Locke, E. A., Frederick, E., Lee, C., & Bobko, P. (1984). The effect of self-efficacy, goals, and task strategies on task performance. Journal of Applied Psychology, 69, 241-251.

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal setting and task performance: 1969-1980. Psychological Bulletin, 90(1), 125-152.

Lodahl, T. M., & Kejner, M. (1965). The definition and measurement of job involvement. Journal of Applied Psychology, 49, 24-33.

Luthans, F., & Davis, T. (1979). Behavioral self-management: The missing link in managerial effectiveness. Organizational Dynamics, 8(1), 42-60.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Luthans, F, & Kreitner, R. (1985). Organizational behavior modification and beyond. Glenview, IL: Scott Foresman.

Mann, R., & Decker, P. J. (1984). The effect of key behavior distinctiveness on generalization and recall in behavior modeling training. Academy of Management Journal, 27(4), 900-910.

Marsh, R. M., & Mannari, H. (1977). Organizational commitment and turnover: A prediction study. Administrative Science Quarterly, 22, 57-75.

Marx, R. D. (1982). Relapse prevention for managerial training: A model for maintenance of behavior change. Academy of Management Review, 7(3), 433-441.

Mathieu, J. E. (1988). A causal model of organizational commitment in a military training environment. Journal of Vocational Behavior, 32, 321-335.

Mathieu, J. E., & Farr, J. L. (1991). Further evidence for the discriminant validity of measures of organizational commitment, job involvement, and job satisfaction. Journal of Applied Psychology, 76, 127-133.

Mathieu, J. E., & Hamel, K. (1989). A causal model of the antecedents of organizational commitment among professionals and nonprofessionals. Journal of Vocational Behavior, 76, 127-133.

Mathieu, J. E., & Zajac, D. M. (1990). A review and meta-analysis of the antecedents, correlated, and consequences of organizational commitment. Psychological Bulletin, 108(2), 171-194.

Mathieu, J. E., Martineau, J. W., & Tannenbaum, S. I. (1993). Individual and situational influences on the development of self-efficacy: Implications for training effectiveness. Personnel Psychology, 46, 125-147.

Mathieu, J. E., Tannenbaum, S. I., & Salas, E. (1992). Individual and situational influences on measures of training effectiveness. Academy of Management Journal, 35(4), 828-847.

Mathieu, J. E., & Zajac, D. M. (1990). A review and meta-analysis of the antecedents, correlates, and consequences of organizational commitment. Psychological Bulletin, 108(2), 171-194.

Mayer, S. J., & Russell, J. S. (1987). Behavior modeling training in organizations: Concerns and conclusions. Journal of Management, 13(1), 21-40.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

McFarlane, R., Shore, L., & Wayne. S. J. (1993). Commitment and employee behavior: Comparison of affective commitment and continuance commitment with perceived organizational support. Journal of Applied Psychology, 78(5), 774-780.

Merriam, S. B. & Caffarella, R. S. (1991). Learning in adulthood. San Francisco: Jossey-Bass.

Meyer, H. H., & Raich, M. S. (1983). An objective evaluation of a behavior modeling training program. Personnel Psychology, 36, 755-761.

Meyer, J. P., & Allen, N. J. (1984). Testing the "side-bet theory" of organizational commitment: Some methodological considerations. Journal of Applied Psychology, 69, 372-378.

Meyer, J. P., Paunonen, S. V., Gellatly, I. R., Goffin, R. D., & Jackson, D. N. (1989). Organizational commitment and job performance: It's the nature of the commitment that counts. Journal of Applied Psychology, 74(1), 152-156.

Michalak, D. F. (1981). The neglected half of training. Training and Development Journal, 5, 22-28.

Moses, J. L., & Ritchie, R. J. (1976). Supervisory relationships training: A behavioral evaluation of a behavior modeling program. Personnel Psychology, 29, 337-343.

Mowday, R. T., Porter, L. W., & Dubin, R. (1974). Unit performance, situational factors, and employee attitudes in spatially separated work units. Organizational Behavior and Human Performance, 12, 231-248.

Mowday, R. T., Porter, L. W., & Steers, R. M. (1982). Employee-organizational linkages. New York: Academic Press.

Mowday, R. T., Steers, R., & Porter, L. (1979). The measurement of organizational commitment. Journal of Vocational Behavior, 14, 224-247.

Newstrom, J. W. (1986). Leveraging management development through the management of transfer. Journal of Management Development, 5(5), 34-45.

Noe, R. A. (1986). Trainee's attributes and attitudes: Neglected influences on training effectiveness. Academy of Management Review, 11(4), 736-749.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Noe, R. A., & Ford, J. K. (1992). Emerging issues and new directions for training research. Research in Personnel and Human Resource Management, 10, 345-384.

Noe, R. A., & Schmitt, N. (1986). The influence of trainee attitudes on training effectiveness: Test of a model. Personnel Psychology, 39, 497-523.

Noe, R. A., Sears, J., & Fullencamp, A. M. (1990). Relapse training: Does it influence trainees' post training behavior and cognitive strategies? Journal of Business and Psychology, 4(3), 319-328.

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric Theory. New York: McGraw-Hill.

O'Connor, E. J., Peters, L. H., Pooyan, A., Weekley, J., Frank, B., & Erenkrantz, B. (1984). Situational constraint effects on performance, affective reactions, and turnover: A field replication and extension. Journal of Applied Psychology, 69(4), 663-672.

Oldham, G. R. (1976). The motivational strategies used by supervisors: Relationships to effectiveness indicators. Organizational Behavior and Human Performance, 15, 66-86.

Olson, D. M., & Borman, W. C. (1989). More evidence on relationships between the work environment and job performance. Human Performance, 2, 113-130.

Ostroff, C., & Ford, K. N. (1989). Assessing training needs: Critical levels of analysis. In I. L. Goldstein (Ed.), Training and development in organizations (pp. 25-62). San Francisco: Jossey-Bass.

Peery, N. S., & Salem, M. (1993). Strategic management of emerging human resource issues. Human Resource Development Quarterly, 4(1), 81-95.

Peixoto, J. L., & LaMotte, L. R. (1989). Simultaneous identification of outliers and predictors using variable selection techniques. Journal of Statistical Planning and Inference, 23, 327-343.

Peters, L. H., Chassie, M. B., Lindholm, H. R., O'Connor, E. J., & Kline, C. R. (1982). The joint influence of situational constraints and goal setting on performance and affective outcomes. Journal of Management, 8(2), 7-20.

Peters, L. H., Fisher, C. D., & O'Connor, E. J. (1982). The moderating effect of situational control of performance variance on the relationship between individual differences and performance. Personnel Psychology, 35, 609-621.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Peters, L. H., & O'Connor, E. J. (1980). Situational constraints and work outcomes: The influences of a frequently overlooked construct. Academy of Management Review, 5(3), 391-397.

Peters, L. H., O'Connor, E. J., & Eulberg, J. R. (1985). Situational constraints: Sources, consequences, and future considerations. In K. H. Rowland and G. Ferris (Eds.), Research in personnel and human resources, Volume 3 (pp. 79-113). Greenwich, CT: JAI Press.

Peters, L. H., O'Connor, E. J., & Eulberg, J. R., Watson, T. W. (1988). An examination of situational constraints in Air Force work settings. Human Performance, 1(2), 133-144.

Peters, L. H., O'Connor, E. J., & Rudolf, C. J. (1980). The behavioral and affective consequences of performance-relevant situational variables. Organizational Behavior and Human Performance, 25, 79-96.

Phillips, J. J. (1991). Handbook of training evaluation and measurement methods (2nd ed.). Houston: Gulf Publishing Company.

Phillips, J. S., & Freedman, S. M. (1984). Situational performance constraints and task characteristics: Their relationship to motivation and satisfaction. Journal of Management, 10(3), 321-331.

Poon, L. W., Krauss, I., & Bowles, N. L. (1984). On subject selection in cognitive aging research. Experimental Aging Research, 10, 43-49.

Porras, J. I., & Anderson, B. (1991). Improving managerial effectiveness through modeling-based training. Organizational Dynamics, 60-77.

Porter, L. W., Steers, R. M., Mowday, R. T., & Boulian, P. V. (1974). Organizational commitment, job satisfaction, and turnover among psychiatric technicians. Journal of Applied Psychology, 59, 603-609.

Preskill, H. (1994). Evaluation's role in enhancing organizational learning. Evaluation and Program Planning, 17(3), 291-297.

Preskill, H., & Kusy, M. E. (1994). Supporting employees' learning transfer: The role of the manager and the organization. In A. Brooks & K. Watkins (Eds.), Proceedings of the first annual conference of the Academy of Human Resource Development (pp. 128-133). San Antonio: University of Texas at Austin Press.

Quinones, M. A. (1995). Pretraining context effects: Training assignments as feedback. Journal of Applied Psychology, 80(2), 226-238.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reber, R. A., & Wallin, J. A. (1984). The effects of training, goal setting, and knowledge of results on safe behavior: A component analysis. Academy of Management Journal, 27(3), 544-560.

Reichers, A. E. (1985). A review and reconceptualization of organizational commitment. Academy of Management Review, 10, 465-476.

Reichers, A. E., & Schneider, B. (1990). Climate and culture: An evolution of constructs. In B. Schneider (Ed.), Organizational culture and climate (pp. 5-39). San Francisco: Jossey-Bass.

Robertson, I. T., Bell, R., & Sadri, G. (1991). Behavior modeling training: Variations in retention processes. Personnel Review, 20(4), 25-28.

Robertson, I., & Downs, S. (1979). Learning and the prediction of performance: Development of trainability testing in the United Kingdom. Journal of Applied Psychology, 64(1), 42-50.

Robinson, D. G., & Robinson, J. C. (1985). Breaking barriers to skill transfer. Training and Development Journal, 1, 82-83.

Robinson, D. G., & Robinson, J. C. (1989a). Training for impact: How to link training to business needs and measure the result. San Francisco: Jossey-Bass.

Robinson, D. G., & Robinson, J. C. (1989b). Training for impact. Training and Development Journal, 43(8), 34-42.

Robinson, D. G., & Robinson, J. C. (1995). Performance consulting: Moving beyond training. San Francisco: Berrett-Koehler Publishers.

Rothwell, W. J., & Sredl, H. J. (1992). The ASTD reference guide to professional human resource development roles and competencies (2nd ed.). Amherst, MA: HRD Press, Inc.

Rouiller, J. Z. (1989). Determinants of the climate for transfer of training. Unpublished doctoral dissertation, University of Maryland.

Rouiller, J. Z., & Goldstein, I. L. (1993). The relationship between organizational transfer climate and positive transfer of training. Human Resource Development Quarterly, 4(4), 377-390.

Rousseau, D. M. (1988). The construction of climate in organizational research. In C. L. Cooper and I. Robertson (Eds.), International Review of Industrial and Organizational Psychology (pp. 139-158). New York: John Wiley & Sons Ltd.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Royer, J. M. (1979). Theories of the transfer of learning. Educational Psychologist, 14, 53-69.

Rummler, G. A., & Brach, A. P. (1990). Improving performance. San Francisco: Jossey-Bass.

Russell, J. S., Terborg, J. R., Powers, M. L. (1985). Organizational performance and organizational level training and support. Personnel Psychology, 38, 849-863.

Russell, J. S., Wexley, K. N., & Hunter, J. E. (1984). Questioning the effectiveness of behavior modeling training in an industrial setting. Personnel Psychology, 37, 465-481.

Ryman, D. H., & Biersner, R. J. (1975). Attitudes predictive of diving training success. Personnel Psychology, 28, 181-188.

Salancik, G. R. (1977). Commitment and the control of organizational behavior and belief. In B. M. Staw & G. R. Salancik (Eds.), New Directions in Organizational Behavior (pp. 1-54). Chicago: St. Clair Press.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. Educational Psychologist, 24, 113-142.

Saari, L. M., Johnson, T. R., McLaughlin, S. D., & Zimmerle, D. M. (1988). A survey of management training and education practices in U.S. companies. Personnel Psychology, 41, 731-743.

Schmidt, F. L., Hunter, J. E., & Caplan, J. R. (1981). Validity generalization results for two groups in the petroleum industry. Journal of Applied Psychology, 66, 261-273.

Schmidt, R. A., & Young, D. E. (1987). Transfer of movement control in motor skill learning. In S. M. Cormier & J. D. Hagman (Eds.), Transfer of Learning (pp. 48-79). San Diego, CA: Academic Press.

Schneider, B. (1975). Organizational climates: An essay. Personnel Psychology, 19, 447-479.

Schneider, B. (1980). The service organization: Climate is crucial. Organizational Dynamics, 52-65.

Schneider, B. (1983). Interactional psychology and organizational behavior. In L. L. Cummings & B. M. Staw (Eds.), Research in organizational behavior (vol. 5, pp.1-31). Greenwich, CT: JAI.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Schneider, B., & Hall, D. T. (1972). Toward specifying the concept of work climate: A study of Roman Catholic diocesan priests. Journal of Applied Psychology, 56(6), 447-455.

Schneider, B., & Reichers, A. E. (1983). On the etiology of climates. Personnel Psychology, 36, 19-39.

Simon, C. W., & Roscoe, S. N. (1984). Application of a multi factor approach to transfer of training research. Human Factors, 26, 591-612.

Sleezer, C. M. (1993). Training needs assessment at work: A dynamic process. Human Resource Development Quarterly, 4(3), 247-264.

Smith-Jentsch, K. A., Jentsch, F. G., Payne, S. C., & Salas, E. (1996). Can pretraining experiences explain individual differences in learning? Journal of Applied Psychology, 81(1), 110-116.

Sorcher, M., & Spence, R. (1982). The Interface project: Behavior modeling and social technology in South Africa. Personnel Psychology, 35(3), 557-582.

Spector, P. E. (1982). Behavior in organizations as a function of employee's locus of control. Psychological Bulletin, 91(3), 482-497.

Spector, P. E. (1987). Method variance as an artifact in self-reported affect perceptions at work: Myth or significant problem? Journal of Applied Psychology, 72, 438-444.

Steers, R. M. (1977). Antecedents and outcomes of organizational commitment. Administrative Science Quarterly, 22, 46-56.

Steers, R. M., & Porter, L. W. (1991). Motivation and work behavior (5th ed.). New York: McGraw Hill.

Steele, R. P., & Ovalle, N. K. (1984). A review and meta-analysis of research on the relationship between behavioral intentions and employee turnover. Journal of Applied Psychology, 69, 673-686.

Steiner, D. D., Dobbins, G. H., & Trahan, W. A. (1991). The trainer-trainee interaction: An attributional model of training. Journal of Organizational Behavior, 12, 271-286.

Sterns, H. L., & Doverspike, D. (1989). Aging and the training and learning process. In I. L. Goldstein (Ed.), Training and Development in Organizations (pp. 299-332). San Francisco: Jossey-Bass.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Storms, P. L., & Spector, P. E. (1987). Relationships of organizational frustration with reported behavioral reactions: The moderating effects of locus of control. Journal of Occupational Psychology, 60, 227-234.

Swanson, R. A. (1994). Analysis for improving performance: Tools for diagnosing organizations and documenting workplace expertise. San Francisco: Berrett-Koehler Publishers.

Tannenbaum, S. I., Mathieu, J. E., Salas, E., & Cannon-Bowers, J. A. (1991). Meeting trainees' expectations: The influence of training fulfillment on the development of commitment, self-efficacy, and motivation. Journal of Applied Psychology, 76, 759-769.

Tannenbaum, S. I., & Yukl, G. (1992). Training and development in work organizations. Annual Review of Psychology, 43, 399-441.

Taylor, M. S., Locke, E. A., Lee, C., & Gist, M. E. (1984). Type A behavior and faculty research productivity: What are the mechanisms? Organizational Behavior and Human Performance, 34, 402-418.

Tett, R. P., Jackson, D. N., & Rothstein, M. (1991). Personality measures as predictors of job performance: a meta-analytic review. Personnel Psychology, 44, 703-742.

Thoms, P., & Klein, H. J. (1992). Participation and evaluative outcomes in management training. Human Resource Development Quarterly, 5(1), 27-39.

Thorndike, R. L. (1986). The role of general ability in prediction. Journal of Vocational Behavior, 29, 332-339.

Thorland-Oster, V. (1987). Transfer of training. In New directions for training and development: Problems and solutions. Ames, IA: American Society for Training and Development, Iowa chapter (ERIC Document Reproduction Service No. ED 289 976).

Thorndike, E. L, & Woodsworth, R. S. (1901). (I) The influence of improvement in one mental function upon the efficiency of other functions. (II) The estimation of magnitudes. (III) Functions involving attention, observation, and discrimination. Psychological Review, 8, 247-261, 384-395, 553-564.

Tiemann, P. W., & Markle, S. M. (1990). Effects of varying interactive strategies provided by computer-based tutorials for a software application program. Performance Improvement Quarterly, 3(2), 48-64.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Tracy, J. B. (1992). The effects of organizational climate and culture on the transfer of training. Unpublished doctoral dissertation, State University of New York at Albany.

Tracy, J. B., Tannenbaum, S. I., & Kavanaugh, M. J. (1995). Applying trained skills on the job: The importance of the work environment. Journal of Applied Psychology, 80, 239-252.

Tziner, A, Haccoun, R. R., & Kadish, A. (1991). Personal and situational characteristics influencing the effectiveness of transfer of training improvement strategies. Journal of Occupational Psychology, 64, 167-177.

Vandenput, M. A. E. (1973). The transfer of training: Some organizational variables. Journal of European Training, 2(3), 251-263.

Vroom, V. H. (1964). Work and motivation. New York: John Wiley & Sons, Inc.

Webb, N. M. (1987). Peer interaction and learning with computers in small groups. Computers in Human Behavior, 3, 193-209.

Wexley, K. N. (1984). Personnel training. Annual Review of Psychology, 35, 519-551.

Wexley, K. N., & Baldwin, T. T. (1986). Posttraining strategies for facilitating positive transfer: An empirical exploration. Academy of Management Journal, 29(3), 503-520.

Wexley, K. N., & Latham, G. P. (1991). Developing and training human resources in organizations (2nd ed.). New York: Harper-Collins.

Wexley, K. N., Nemeroff, W. (1975). Effectiveness of positive reinforcement and goal setting as methods of management development. Journal of Applied Psychology, 64, 239-246.

Xiao, J. (1996). The relationship between organizational factors and the transfer of training in the electronics industry in Shenzhen, China. Human Resource Development Quarterly, 7(1), 55-86.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. Journal of Applied Psychology, 65(1), 96-102

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX A: CONSTRUCT SCALES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Climate Scales

Supervisor Support

1. My supervisor discussed performance expectations (based on training) with me shortly after the training.
2. My supervisor sets goals for me which encourage me to apply my training on the job.
3. My supervisor expects me to make use of my training.
4. My supervisor helps me set realistic goals for job performance based on my training.
5. My supervisor makes sure that I have opportunities to use my training immediately.
6. My supervisor provides occasional practice sessions for important but seldom used skills.
7. My supervisor meets with me to discuss ways to apply training on the job.
8. My supervisor has me share my training experience and learning with colleagues on the job.
9. My supervisor gives me instructions on how to do the job, which are the same as those learned in training.
10. My supervisor involves me in work related decisions based on my training.
11. My supervisor meets regularly with me to work on problems I may be having in trying to use my training.
12. My supervisor shows interest in what I learn in training.
13. My supervisor eases the pressures of work for a short time so I have a chance to practice my new skills.
14. My supervisor lets me know I am doing a good job when I use my training.
15. My supervisor appreciates my operating the unit as taught in training.
16. My supervisor does not notice me when I use my training.
17. My supervisor is involved in determining what training is needed.
18. My supervisor and I discuss problems in using my training.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

19. My supervisor assigns me to work with more experienced colleagues, after training, until I become familiar with the new practices.

20. My supervisor phrases statements or actions in terms that I can recognize as coming from the training.

21. My supervisor can be counted on to give me answers to questions about the use of training on the job.

22. My supervisor gives me praise such as telling me I have performed well when I use my training.

23. My colleague and my supervisor help each other resolve difficult problems relating to the use of training on the job,

Opportunity to Use

1. Training aids are available on the job to support what I learned in training.
2. Information describing the procedures taught in training is available to me after training if I need them to complete my work .
3. Equipment is available in this unit that allows me to use the skills I gained in training.
4. There are enough human resources available in my unit to allow me to use skills learned in training.
5. The financial resources are available that will allow me to use skills acquired in training.
6. I am able to use the procedures taught in training even if others do not.
7. The materials and supplies are available to me to allow me to use the skills and knowledge learned in training.

Transfer Design

1. During CATS training I am taught how to use my new skills in assigned units.
2. During CATS training I practice using the skills taught.
3. During CATS training I learn how to handle mistakes that I might make later on the job.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

4. During CATS training I am taught how to apply my new knowledge back on the job.
5. During CATS training I am allowed to practice handling real and job related problems.

Peer Support

1. My colleagues have the technical knowledge to help me use the techniques learned in training.
2. My colleagues appreciate my operating the unit as taught in training.
3. My colleagues encourage me to use the skills I learned in training.
4. My colleagues do not use the skills they are taught in training.
5. My colleagues think I am being ineffective when I use the techniques taught in training.
6. My colleagues and I discuss how to apply our training on the job.
7. My colleagues in this unit expect me to perform my job in a manner that is consistent with my training.

Change Resistance

1. The skills I learned in training could be used in my job but I prefer to use the old methods.
2. More experienced colleagues ridicule me when I use the techniques I learned in training.
3. The skills taught in training do not fit the "image" of my work group.
4. I am afraid colleagues will think I am weak if I use the new skills learned in training.

Supervisor Sanctions

1. My supervisor opposes the use of the techniques learned in training that I bring to the unit.
2. My supervisor doesn't seem to care whether I use my training or not.
3. My supervisor pays only lip service to the value and usefulness of training.
4. My supervisor would use different techniques than those I would be using if I use my training.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

5. My supervisor thinks I am being ineffective when I use the techniques taught in training.

6. I am not allowed enough time to do my job as taught in the training program.

Negative Personal Outcomes

1. If I do not use my training I am unlikely to get a raise.

2. If I do not use new techniques taught in training I will be reprimanded.

Positive Personal Outcomes

1. If I successfully use my training, I will receive a salary increase.

2. The use of training on the job can help me meet some of the career development plans I have.

3. I do not know how training contributes to my advancement in the unit.

Content Validity

1. Equipment illustrated in the training does not operate the same way as the equipment in this unit.

2. The standard operating procedures taught in the training are correct.

3. Skills and knowledge taught in the training are the same skills and knowledge needed to do a good job.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Organizational Commitment Scale

1. I am proud to tell others that I am part of this organization.
2. I really care about the fate of this organization.
3. I boast about this organization to my friends as a great organization to work for.
4. I find that my values and the organization's values are very similar.
5. Overall, I am satisfied with my current job.
6. Given what I know about other organizations, this is the best organization for me.
7. The organization really inspires the very best in me in the way of job performance.
8. I am generally satisfied with the kind of work I do in this job.
9. I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful.
10. I would accept almost any type of job assignment in order to keep working for this organization.
11. I am glad I chose this organization to work for over others I was considering at the time I joined.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Performance Utility Scale

1. I plan to use what I learned on the job.
2. Because of the training, I understand better why it is important to do certain procedures as specified in the SOP's.
3. I believe the training will help me do my current job better.
4. The training reminded me how the steps in the SOP's should be done.
5. The training covered the areas in needed training on.
6. I feel good knowing everyone is being trained on the same standard operating procedures.
7. I learned several new things during the training.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX B: INSTRUMENTS

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

TRANSFER CLIMATE

NAME ____________________ SHIFT# ____________________

Thinking about safety and standard operating procedure training you have had in the past, please indicate how you feel at this time by marking the numbered circle that most closely agrees with your feelings for each item. Use the scale shown below.

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree 4 - Agree 5 - Strongly agree

	My advisor . . .					
1.	. . . discusses performance expectations (based on training)with me shortly after the training is completed.	0	1	2	3	4
2.	. . . sets goals for me which encourage me to apply my training on the job.	0	1	2	3	4
3.	. . . expects me to make use of my training.	0	1	2	3	4
4.	. . . helps me set realistic goals for job performance based on my training.	0	1	2	3	4
5.	. . . makes sure that I have opportunities to use my training immediately.	0	1	2	3	4
6.	. . . is knowledgeable concerning areas in which I receive training.	0	1	2	3	4
7.	. . . provides occasional practice sessions for important but seldom used skills.	0	1	2	3	4
8.	. . . meets with me to discuss ways to apply training on the job.	0	1	2	3	4
9.	. . . has me share my training experience and learning with colleagues on the job.	0	1	2	3	4
10.	. . . gives me instructions on how to do the job, which are the same as those learned in training.	0	1	2	3	4
11	. . . involves me in work related decisions based on my training.	0	1	2	3	4
12.	. . . meets regularly with me to work on problems I may be having in trying to use my training.	0	1	2	3	4
13.	. . . shows interest in what in learn in training.	0	1	2	3	4
14.	. . . eases the pressures of work for a short time so I have a chance to practice my new skills.	0	1	2	3	4
15.	. . . lets me know I am doing a good job when I use my training.	0	1	2	3	4
16.	. . . appreciates my operating the unit as taught in training.	0	1	2	3	4
17.	. . . refuses to accept statements or actions from me that are different from those learned in training.	0	1	2	3	4
18.	. . . opposes the use of the techniques learned in training that I bring to the unit.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree
4 - Agree 5 - Strongly agree

	My advisor . . .					
19.	. . . does not notice when I use my training.	0	1	2	3	4
20.	. . . is involved in determining what training is needed.	0	1	2	3	4
21.	. . . Doesn't seem to care whether I use my training or not.	0	1	2	3	4
22.	. . . pays only lip service to the value and usefulness of training.	0	1	2	3	4
23.	. . . and I discuss problems in using my training.	0	1	2	3	4
24.	. . . assigns me to work with more experienced colleagues, after training, until I become familiar with the new practices.	0	1	2	3	4
25.	. . . phrases statements or actions in terms that I can recognize as coming from the training.	0	1	2	3	4
26.	. . . can be counted on to give me answers to questions about the use of training on the job.	0	1	2	3	4
27	. . . gives me praise such as telling me I have performed well when I use my training.	0	1	2	3	4
28.	. . . would use different techniques than those I would be using if I use my training.	0	1	2	3	4
29.	. . . thinks I am being ineffective when in use the techniques taught in training.	0	1	2	3	4
	My Colleagues . . .					
30.	. . . have the technical knowledge to help me use the techniques learned in training.	0	1	2	3	4
31.	. . . appreciate my operating the unit as taught in training.	0	1	2	3	4
32.	. . . encourage my operating the unit as taught in training.	0	1	2	3	4
33.	. . . do not use the skills they are taught in training.	0	1	2	3	4
34.	. . . and in have a lot of interaction on the job.	0	1	2	3	4
35.	. . . think I am being ineffective when in use the techniques taught in training.	0	1	2	3	4
		0	1	2	3	4
36.	. . . and in discuss how to apply our training on the job.					
37.	. . . and in discuss problems that arise in using training techniques.	0	1	2	3	4
38.	. . . and my advisor help each other resolve difficult problems relating to the use of training on the job.	0	1	2	3	4
39.	. . . in this unit expect me to perform my job in a manner that is consistent with my training.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree
4 - Agree 5 - Strongly agree

	Thinking about on the job . . .					
40.	The skills I learned in training could be used in my job but I prefer to use the old methods.	0	1	2	3	4
41.	The jobs are designed in such a way as to allow me to sue the skills taught in training.	0	1	2	3	4
42.	Training aids are available on the job to support what I learned in training.	0	1	2	3	4
43.	Information describing the procedures taught in training is available to me after training if I need them to complete my work.	0	1	2	3	4
44.	Equipment is available in this unit that allows me to use the skills I gained in training.	0	1	2	3	4
45.	Equipment illustrated in the training does not operate the same way as the equipment in this unit.	0	1	2	3	4
46.	There are enough human resources available in my unit to allow me to use skills learned in training.	0	1	2	3	4
47	The financial resources are available that will allow me to use skills acquired in training.	0	1	2	3	4
48.	I am able to use the procedures taught in training even if others do not.	0	1	2	3	4
49.	The materials and supplies are available to me to allow me to sue the skills and knowledge learned in training.	0	1	2	3	4
50.	I am not allowed enough time to do my job as taught in the training program.	0	1	2	3	4
51.	If I successfully use my training, I will receive a salary increase.	0	1	2	3	4
52.	The use of training on the job can help me meet some of the career development plans I have.	0	1	2	3	4
53.	If I do not use my training I am unlikely to get a raise.	0	1	2	3	4
54.	If I do not use new techniques taught in training in will be reprimanded.	0	1	2	3	4
55.	More experienced colleagues ridicule me when in use the techniques I learned in training.	0	1	2	3	4
56.	Following the procedures and policies taught in training results in my being told that I am not performing correctly.	0	1	2	3	4
57.	The skills taught in training do not fit the "image" of my work group.	0	1	2	3	4
58.	I am afraid colleagues will think I am weak if I use the new skills learned in training.	0	1	2	3	4
59.	I do not know how training contributes to my advancement in the unit.	0	1	2	3	4
60.	The standard operating procedures taught in the training are correct.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree
4 - Agree 5 - Strongly agree

61.	Skills and knowledge taught in the training are the same skills and knowledge needed to do a good job.	0	1	2	3	4
	During Safety and SOP training . . .					
62.	. . . I am taught how to use my new skills in assigned units.	0	1	2	3	4
63.	. . . I practice using the skills taught.	0	1	2	3	4
64.	. . . I learn how to handle mistakes that I might make later on the job.	0	1	2	3	4
65.	. . . I am taught how to apply my new knowledge back on the job.	0	1	2	3	4
66	. . . I am allowed to practice handling real and job related problems.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

JOB ATTITUDE SURVEY

NAME ______________________________ SHIFT# ______________

For these items, please think how you feel about the organization for which you are now working and the job you are in. Mark the response that most closely matches your opinion

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree
4 - Agree 5 - Strongly agree

1.	Overall, I am satisfied with my current job.	0	1	2	3	4
2.	I am generally satisfied with the kind of work I do in this job.	0	1	2	3	4
3.	I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful.	0	1	2	3	4
4.	I boast about this organization to my friends as a great organization to work for.	0	1	2	3	4
5.	I would accept almost any type of job assignment in order to keep working for this organization.	0	1	2	3	4
6.	I find that my values and the organization's values are very similar.	0	1	2	3	4
7.	I am proud to tell others that I am part of this organization.	0	1	2	3	4
8.	This organization really inspires the very best in me in the way of job performance.	0	1	2	3	4
9.	I am glad that I chose this organization to work for over others I was considering at the time I joined.	0	1	2	3	4
10	I really care about the fate of this organization.	0	1	2	3	4
11.	Given what in know about other organizations, this is the best organization for me.	0	1	2	3	4
12.	I feel a great sense of personal satisfaction when I do my job well.	0	1	2	3	4
13.	Doing my job well increases my feeling of self-esteem.	0	1	2	3	4
14	I feel bad when I do my job poorly.	0	1	2	3	4
15.	The major satisfaction in my life comes from my job.	0	1	2	3	4
16.	The most important things that happen to me involve my work.	0	1	2	3	4
17.	I live, eat, and breathe my job.	0	1	2	3	4
18.	I am very much personally involved in my work.	0	1	2	3	4
19.	I often think of quitting this job.	0	1	2	3	4
20	I expect to begin searching fore another job in the next year.	0	1	2	3	4
21	I expect to resign from this job within the next year.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1 - Strongly disagree | 2 - Disagree | 3 - Neither agree nor disagree
4 - Agree | 5 - Strongly agree

22.	I have not been especially proud of my performance in my job lately.	0	1	2	3	4
23.	Generally, I feel I am achieving my most important personal work goals.	0	1	2	3	4
24	On the basis of my own standards, I feel I have been successful in my work.	0	1	2	3	4
25.	I get a great sense of accomplishment in my job.	0	1	2	3	4
26.	I often feel really good about the quality of my work performance.	0	1	2	3	4
27	Compared to my peers, I feel quite successful in my career.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

REACTION TO TRAINING

NAME ______________________ SHIFT# ______________

Relating to the CATS training, for each item below, please indicate how you feel at this time by marking the numbered circle that most closely agrees with your feelings. Use the scale shown below.

1 - Strongly disagree   2 - Disagree   3 - Neither agree nor disagree
4 - Agree   5 - Strongly agree

1.	The instructions were easy to follow.	0	1	2	3	4
2.	I was able to understand the meanings of all the words used in the lessons.	0	1	2	3	4
3.	I enjoyed using the computer to learn the material.	0	1	2	3	4
4	The style of print used was easy to read.	0	1	2	3	4
5	The lines of print on the screen were too close together.	0	1	2	3	4
6.	The training was boring.	0	1	2	3	4
7.	The graphics (pictures, drawings, and videos) helped me to understand the material.	0	1	2	3	4
8	The graphics (pictures, drawings, and videos) made the lessons more interesting.	0	1	2	3	4
9.	It is generally not too noisy in my unit to be able to work on the computer.	0	1	2	3	4
10.	The computer is in a sell-lighted area in my unit.	0	1	2	3	4
11.	The setting for the training made it difficult for me to learn.	0	1	2	3	4
12.	I am involved in determining what training is needed in my unit.	0	1	2	3	4
13.	I am satisfied with the amount of choice I have in selecting the training I attend.	0	1	2	3	4
14.	I would like to be more involved in the design of the training programs.	0	1	2	3	4
15.	I am given choices of which training I take.	0	1	2	3	4
16.	I learned several new things during the training.	0	1	2	3	4
17.	The training reminded me how the steps in the SOPs should be done.	0	1	2	3	4
18.	The training was a waste of my time.	0	1	2	3	4
19.	I feel good knowing everyone is being trained on the same standard operating procedures.	0	1	2	3	4
20.	The training covered the areas that I needed training on.	0	1	2	3	4
21.	I knew the standard operating procedures (SOPs) well enough that I had to spend very little time going over the computer lessons in order to pass the test.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1 - Strongly disagree 2 - Disagree 3 - Neither agree nor disagree
4 - Agree 5 - Strongly agree

22.	I believe the training will in crease my future job opportunities at Ciba-Geigy.	0	1	2	3	4
23.	The lessons have motivated me to want to learn more.	0	1	2	3	4
24.	I believe the training will help me do my current job better.	0	1	2	3	4
25.	Because of the training, I understand better why it is important to do certain procedures as specified tin the SOPs.	0	1	2	3	4
26.	I plan to use what I learned on the job.	0	1	2	3	4
27.	There was enough time during my shift to use the computer.	0	1	2	3	4
28	The way the information was organized helped me learn.	0	1	2	3	4
29	It takes too much time to work through each lesson.	0	1	2	3	4
30.	I like completing the lessons at my own pace.	0	1	2	3	4
31.	Having the standard operating procedures on the computer will make it easy to find information when I need ti in the future.	0	1	2	3	4
32.	Refresher training on the procedures should be repeated every two years instead of every 3 years as required by law.	0	1	2	3	4
33.	Training on the computer would be a good way to learn skills I will use I the future.	0	1	2	3	4
34.	The tests covered the most important information in each lesson.	0	1	2	3	4
35.	The questions on the test were taken from information that was well covered in the lessons.	0	1	2	3	4
36.	The tests were not too hard.	0	1	2	3	4
37.	The computer training I was give before starting he certification lessons, taught me how to go through each lesson with little difficulty.	0	1	2	3	4
38.	After being shown how to use the computer, I was able to move back and forth among the different study sections and the tests as needed.	0	1	2	3	4
39.	I do not want to go back to the old way of conducting training.	0	1	2	3	4
40.	I do better on the tests when I have worked through the lessons alone.	0	1	2	3	4
41.	It would help me to learn better if I could work with a partner or colleague on the computer.	0	1	2	3	4
42.	When I get a question wrong on a test, it would be helpful to know why my answer in incorrect.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX C: CRITICAL PROCEDURES WORKSHEET

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Critical Procedures Worksheet: Identifying Critical Procedures

With your help, we would like to identify the most important or critical SOPs in your unit. Your colleagues have helped us identify the following criteria as the best ones to use in identifying critical procedures. Using these criteria, please list on the attached worksheet the most critical procedures in your unit. Fill in the procedure title, number, and by whom it is performed. Then check the appropriate box indicating which criteria make the procedure critical. For example, if the procedure were critical for safety and quality then you would place checks in each of these boxes. Finally, check the box indicating how frequently the procedure is performed.

Critical Procedure Selection Criteria

1. **Is the procedure tied to a behavior that can be visually observed?** SOPs which cannot be directly linked to an observable job behavior should not be listed as critical. For example, this would exclude from the list procedures which are informational in nature and not tied to a physical activity.

2. **Is the procedure performed regularly?** Procedures which are rarely or irregularly performed should note be included in your list. For example, emergency procedures, although important to safety and productivity, should not be included in your list because of the performance of these procedures in infrequent and unpredictable. Regularly performed procedures are procedures that are performed either:
   (A) **Every 12 hour shift**, or
   (B) **Every three day working cycle**, or
   (C) **At least once a month.**

3. **Is the procedure critical to the performance of the unit?** A procedure should be judged to be critical to the performance of a unit if it meets one or more of the following criteria:
   (A) **<u>Safety</u>** -does non-performance of this SOP results in the release of toxic chemicals into the environment, personal injury, or equipment damage or failure?
   (B) **<u>Quality</u>** - does non-performance of this SOP result in contaminants in the final product, unwanted by-products, or re-work time for a product that does not meet required specifications?
   (C) **<u>Production rates</u>** - does non-performance of this SOP result in a decrease in production rates?

*** Non-performance in all of these cases refers to the performance of a procedure that is not completed in a manner that is 100% in accordance with the written SOP.**

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Critical Procedures Worksheet

Procedure title, number, and who performs	Frequency	Safety	Quality	Production		
				Shift	3 day	Month

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX D: PROCEDURE OBSERVATION QUESTIONNAIRES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observations Questionnaire
HCN/Sequestrene

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
01100001.00	Making rounds in Atrazine/Ammonia tank farm.	0	1	2	3	4
01030001.00	Making rounds in the Synthesis area.	0	1	2	3	4
01030028.00	Making rounds in the Ammonia Recovery area.	0	1	2	3	4
01040001.00	Making rounds in the HCN recovery area.	0	1	2	3	4
01040027.00	Making rounds in the WGB area.	0	1	2	3	4
01090001.00	Making rounds in the HCN/Sequestrene tank farm.	0	1	2	3	4
01030002.00	Back flushing the flame arresters.	0	1	2	3	4
01030003.00	Blowing down the sludge in the blowdown vaporizer.	0	1	2	3	4
01030016.00	Draining the ammonia flare knockout pot.	0	1	2	3	4
01030031.00	Switching ammonia storage tanks.	0	1	2	3	4
01040054.00	Adding acid (H2SO4) to the HCN storage tanks.	0	1	2	3	4
01040004.00	Adding antifoam and copper sulfate to the HCN recovery area.	0	1	2	3	4
01040026.00	Analyzing the HCN recovery area samples.	0	1	2	3	4
01040038.00	Analyzing the waste gas boiler samples.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
01040058.00	HCN transfer from tank to tank in the HCN tank farm.	0	1	2	3	4
01040002.00	Sampling the HCN enricher.	0	1	2	3	4
01040056.00	Sampling the HCN storage tanks.	0	1	2	3	4
01040036.00	Waste heat/waste gas boiler chemical makeup.	0	1	2	3	4
01070011.00	Operating the christmas tree manifold.	0	1	2	3	4
01070012.00	Pumping up hydrogen peroxide.	0	1	2	3	4
01100031.00	Taking inventory readings.	0	1	2	3	4
01030037.00	Ammonia/HCN recovery boilout.	0	1	2	3	4
01030021.00	Checking the ignitor probe.	0	1	2	3	4
01030051.00	Handling and disposal of ammonia filters.	0	1	2	3	4
01030044.00	Lining up the ammonia stripper bottoms exchangers.	0	1	2	3	4
01030043.00	Lining up the ammonia stripper mid stream exchangers.	0	1	2	3	4
01030030.00	Loading/unloading trailers into the phosphate storage tank.	0	1	2	3	4
01030009.00	Preparing the converter cone for maintenance to repair.	0	1	2	3	4
01030049.00	Switching the ammonia recycle.	0	1	2	3	4
01030034.00	Cleaning the waste gas boiler steam drum and level pot blowdown sight glass.	0	1	2	3	4
01040032.00	Operating the sulfuric acid system.	0	1	2	3	4
01040012.00	Start-up of the WGB in sequence.	0	1	2	3	4
01040028.00	Switching sulfur dioxide cylinders.	0	1	2	3	4
01040006.00	Flushing the formaldehyde flow meters.	0	1	2	3	4
01070015.00	Refrigeration machine start-up (unit).	0	1	2	3	4
01070005.00	Loading/unloading from 113-F.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
01070029.00	Sequestrene boilout guidelines.	0	1	2	3	4
0110043.00	Putting ammonia delivery pumps in service.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observations Questionnaire
HCN/Sequestrene Tank Farm

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1. 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time   1 - about 25% of the time   2 - about 50% of the time
3 - about 75% of the time   4 - 100% of the time

Procedure #	Procedure Description					
01090001	Making rounds in HCN Sequestrene tank farm.	0	1	2	3	4
01090002	Raw material sump 29208-A	0	1	2	3	4
01090003	Formaldehyde truck unloading.	0	1	2	3	4
01090004	EDA truck unloading	0	1	2	3	4
01090005	Decontamination of formaldehyde tank for vessel entry.	0	1	2	3	4
01090006	DETA truck unloading.	0	1	2	3	4
01090007	AEEA truck unloading.	0	1	2	3	4
01090008	Formaldehyde railcar unloading.	0	1	2	3	4
01090010	Handling an HCN railcar with dark material, high temperature and high pressure.	0	1	2	3	4
01090011	Cleaning the sulfuric acid tank sight glass.	0	1	2	3	4
01090012	Refrigeration machine start-up/shutdown.	0	1	2	3	4
01090013	HCN railcar water washing and orbijetting.	0	1	2	3	4
01090014	HCN railcar loading.	0	1	2	3	4
01090015	HCN railcar acid washing.	0	1	2	3	4
01090016	HCN railcar unloading.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
01090017	Transporting HCN by highway.	0	1	2	3	4
01090017	External preparation of railcar for inspection.	0	1	2	3	4
01090019	HCN tank (2101-FB) preparation for inspection.	0	1	2	3	4
01090020	Sulfuric acid cargo tank unloading.	0	1	2	3	4
01090021	Rupture testing HCN hoses.	0	1	2	3	4
01090023	Operating the trackmobile.	0	1	2	3	4
01090024	Phosphoric acid unloading.	0	1	2	3	4
01090025	Vessel entry on Hcn tank car.	0	1	2	3	4
01090026	Filling drums from the phosphoric acid stroage tank.	0	1	2	3	4
01090027	Pumping out the acid storage tank dike.	0	1	2	3	4
01090028	Operating the hoist.	0	1	2	3	4
01090031	EDA direct from tank truck to unit.	0	1	2	3	4
01090032	Tank inspectin procddure 2101-FA.	0	1	2	3	4
01090033	HCN tank farm supm system.	0	1	2	3	4
01090034	Sequestrene railcar orbijetting.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observations Questionnaire
HCN/Atrazine-Ammonia Tank Farm

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	**Procedure Description**					
01100001	Making rounds.	0	1	2	3	4
01100003	Rail car and cargo tank inspections.	0	1	2	3	4
01100004	Unloading renex from tank trucks.	0	1	2	3	4
01100005	Unloading igepon from tank trucks.	0	1	2	3	4
01100006	Unloading ethylene glycol from tank truck.	0	1	2	3	4
01100007	Unloading polyfon from tank trucks.	0	1	2	3	4
01100008	Unloading sorbit from tank trucks.	0	1	2	3	4
01100009	Unloading witconate from tank trucks.	0	1	2	3	4
01100010	Unloading glycerine from tank trucks.	0	1	2	3	4
01100011	Unloading toluene from tank trucks.	0	1	2	3	4
01100012	Unloading TBA from tank trucks.	0	1	2	3	4
01100013	Unloading TBA from rail car.	0	1	2	3	4
01100014	Unloading polyfon form rail car.	0	1	2	3	4
01100015	Unloading sorbit from rail car.	0	1	2	3	4
01100016	Unloading ethylene glycol from rail car.	0	1	2	3	4
01100017	Unloading P65 (Toximul) from rail car.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
01100018	Unloading renex from rail car.	0	1	2	3	4
01100019	Unloading igepon from rail acar.	0	1	2	3	4
01100020	Loading 4-L rail cars.	0	1	2	3	4
01100023	Off loading 4-L rail cars.	0	1	2	3	4
01100026	Preparation of rail cars for vessel entry.	0	1	2	3	4
01100027	MEA/IPA sampling.	0	1	2	3	4
01100028	Cargo tank and rail car sampling of liquid herbicides.	0	1	2	3	4
01100029	Operating the deluge system.	0	1	2	3	4
01100030	Cleaning the 4-L load lines at the end of a campaign.	0	1	2	3	4
01100031	Taking inventory readings.	0	1	2	3	4
01100032	Orbijetting 4-L cars.	0	1	2	3	4
01100033	Transferring MEA/IPA by pipeline.	0	1	2	3	4
01100034	Making masterbatch for 4-L.	0	1	2	3	4
01100035	Making masterbatch for princep.	0	1	2	3	4
01100036	Decontamination of tank farm vessels.	0	1	2	3	4
01100037	Preparing the ammonia compressors for oil change.	0	1	2	3	4
01100038	Ammonia car sampling.	0	1	2	3	4
01100039	Ammonia rail car unloading.	0	1	2	3	4
01100040	Changing the relief valves on the ammonia storage tanks.	0	1	2	3	4
01100041	Product identity check of ammonia rail cars.	0	1	2	3	4
01100042	Amine system inspection.	0	1	2	3	4
01100043	Putting ammonia delivery pumps in service.	0	1	2	3	4
01100044	Ammonia rail car loading.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observation Questionnaire
HPF/CC

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
020D0005	A & B York operating procedures.	0	1	2	3	4
020D0004	Starting up, operating, and shutting down 'C' York.	0	1	2	3	4
020C0001	Starting up a CNCL train.	0	1	2	3	4
020C0002	CNCL train shutdown.	0	1	2	3	4
020C0003	CNCL train emergency shutdown.	0	1	2	3	4
020C0006	Installing wash out point washing and blinding HCN line to CNCL reactor.	0	1	2	3	4
020C0012	Sampling the CNCL generator bottoms for ammonium chloride.	0	1	2	3	4
020C0023	Taking a CL2 vap out of service and returning it to service after repair.	0	1	2	3	4
020C0024	Clear entire CL2 system from pioneer fence to CC area and E.T. block valve.	0	1	2	3	4
020C0034	Pumping 124-F to 117-F.	0	1	2	3	4
020C0041	Spent carbon treatment.	0	1	2	3	4
020C0047	Making rounds in 'C' area.	0	1	2	3	4
020C0050	Steps to take in 'C' area in the event of a power failure.	0	1	2	3	4
020C0058	Pulling molten CC samples.	0	1	2	3	4
020C0065	Checking for HCN leaks in area 5.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
020C0077	Operating CL2 emergency shut off valves).	0	1	2	3	4
020B0009	Starting up and shutting down the topping still.	0	1	2	3	4
020B0020	Reacting and pumping out 141_F sample rework tank.	0	1	2	3	4
020B0037	Making rounds in 'B' area.	0	1	2	3	4
020B0026	Starting up transfer column and placing recovery area on hot circulation.	0	1	2	3	4
020B0027	Shutting down transfer column and.	0	1	2	3	4
020A0001	Starting up a CNCL train.	0	1	2	3	4
020A0002	Shutting down an CNCL train.	0	1	2	3	4
020A0010	Monitoring the control board.	0	1	2	3	4
020A0011	Increasing and decreasing HCN rates on a CNCL train.	0	1	2	3	4
020A0013	Setting CL2 and water flows to CNCL gen for HCN rate.	0	1	2	3	4
020A0015	Troubleshooting a pressure problem on CNCL train.	0	1	2	3	4
020A0016	Pumping up HCN drop tanks.	0	1	2	3	4
020A0017	Starting and feeding HCN wash water to a CNCL train.	0	1	2	3	4
020A0022	Nitrogen purging from train through the tail gas absorber and CL dissolver.	0	1	2	3	4
020A0023	Heating up and cooling down trimerizers.	0	1	2	3	4
020A0025	Balancing brine flows.	0	1	2	3	4
020A0039	Monitoring levels in distilled, 130-FA, and 130-FB.	0	1	2	3	4
020A0042	Swapping final dryers.	0	1	2	3	4
020A0043	Switching CNCL reactor and HCL stripper pumps.	0	1	2	3	4
020A0045	Taking messages on emergency phone.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
020A0051	Starting up and shutting down topping still.	0	1	2	3	4
020A0052	Points to monitor and action steps if reactor or stripper analyzers are not functioning.	0	1	2	3	4
020D0001	Switching caustic scrubber circulating tanks.	0	1	2	3	4
020D0004	Pumping out a spent caustic tank to E.T.	0	1	2	3	4
020C0005	Swapping CNCL final dryers and regenerating.	0	1	2	3	4
020C0009	Routing check of HCN drop tank system pump system.	0	1	2	3	4
020C0061	Draining the predryers and unplugging the predryer drain lines.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observation Questionnaire
HPF/Atrazine

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time   1 - about 25% of the time   2 - about 50% of the time
3 - about 75% of the time   4 - 100% of the time

Procedure #	**Procedure Description**					
03030008	Sampling the 1st dichloro and the 2nd dichloro reactors for Ph.	0	1	2	3	4
03030009	Pumping the vent relief tank.	0	1	2	3	4
03030010	Swapping the dichloro pumps 143-J and 143-JA.	0	1	2	3	4
03030019	Setting up dichloro piping for maintenance.	0	1	2	3	4
03030023	Washing down dichloro reactor deck.	0	1	2	3	4
03030026	Sampling procedure for caustic.	0	1	2	3	4
03030030	Dumping the reactor sample in the sample dump station.	0	1	2	3	4
03030038	Preparing atrazine samples for injection to obtain analysis.	0	1	2	3	4
03040005	Operating stripper mod with the evaporator.	0	1	2	3	4
03040006	Unplugging the stripper bottoms pumps.	0	1	2	3	4
03040009	Adjusting filter cloth on rotary drum filter.	0	1	2	3	4
03040010	Making up dilute acid for rotary drum filter cloth and scavenger filter wash.	0	1	2	3	4
03040011	Acid washing the rotary drum filter cloth and scavenger filter cloth.	0	1	2	3	4
03040013	Making up surfactant batches with polyfor and sorbit.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure Observation Questionnaire
HPF/Atrazine

Supervisor name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times that your operators or technicians have performed that procedure. Of these times, estimate the percentage of times that you have observed your people performing the procedure. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
03030008	Sampling the 1st dichloro and the 2nd dichloro reactors for Ph.	0	1	2	3	4
03030009	Pumping the vent relief tank.	0	1	2	3	4
03030010	Swapping the dichloro pumps 143-J and 143-JA.	0	1	2	3	4
03030019	Setting up dichloro piping for maintenance.	0	1	2	3	4
03030023	Washing down dichloro reactor deck.	0	1	2	3	4
03030026	Sampling procedure for caustic.	0	1	2	3	4
03030030	Dumping the reactor sample in the sample dump station.	0	1	2	3	4
03030038	Preparing atrazine samples for injection to obtain analysis.	0	1	2	3	4
03040005	Operating stripper mod with the evaporator.	0	1	2	3	4
03040006	Unplugging the stripper bottoms pumps.	0	1	2	3	4
03040009	Adjusting filter cloth on rotary drum filter.	0	1	2	3	4
03040010	Making up dilute acid for rotary drum filter cloth and scavenger filter wash.	0	1	2	3	4
03040011	Acid washing the rotary drum filter cloth and scavenger filter cloth.	0	1	2	3	4
03040013	Making up surfactant batches with polyfor and sorbit.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
03040014	Filter/repulper operation for producing 9-0, basimix, and technical triazine.	0	1	2	3	4
03040018	Unloading sulfuric acid.	0	1	2	3	4
03040026	Lining up caustic to stripper feed tanks and stripper for Ph. Adjustment.	0	1	2	3	4
03040033	Pumping sluice water dike to sluice tank.	0	1	2	3	4
03040037	Swapping vacuum pumps.	0	1	2	3	4
03040040	Unload ammonia soup.	0	1	2	3	4
03040049	Sampling in the stripper/filter area.	0	1	2	3	4
03050003	Formulating base mix for bicep/bicep lite.	0	1	2	3	4
03050004	Formulating Aatrex 4L and Princep 4L.	0	1	2	3	4
03050006	Making gum arabic solution for formulating Aatrex Nine-O and Caliber-90.	0	1	2	3	4
03050009	Making up pre-gel for flowable products Aatrex 4L, Princep 4L, and base mix.	0	1	2	3	4
03050011	Operating the dynomills.	0	1	2	3	4
03050013	Adjusting Ph on forrmulated batches.	0	1	2	3	4
03050014	Adding antifoam to formulated batches.	0	1	2	3	4
03050015	Transferring 4L batches to silos.	0	1	2	3	4
03070002	Spray dryer startup.	0	1	2	3	4
03070003	Atomizer startup.	0	1	2	3	4
03070009	feeding out powder.	0	1	2	3	4
03070010	Cleaning hats on aftergrinder millhead.	0	1	2	3	4
03070017	Switching trim tank feeding spray dryer feed tank.	0	1	2	3	4
03070024	Shutting down the spray dryer for lack of feed.	0	1	2	3	4
03070026	Swapping baghouses on the spray dryer and Cleaning temperature probe on spray dryer exit	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
03070027	Switching powder silos.	0	1	2	3	4
03070031	Starting up and shutting down an aftergrinder system.	0	1	2	3	4
03070032	Rodding out nozzles on wet scrubber.	0	1	2	3	4
03070039	Activating and deactivating total system. Monitoring control board.	0	1	2	3	4
03080001	Monitoring control board.	0	1	2	3	4
03080004	Setting ratios and changing ratios.	0	1	2	3	4
03080005	Starting spray dryer.	0	1	2	3	4
03080006	Making up a batch of surfactant.	0	1	2	3	4
03080007	Run computer programs for foumulations	0	1	2	3	4
03080008	Changing rates on reactors.	0	1	2	3	4
03080012	Adjusting Ph on formulated batches.	0	1	2	3	4
03080014	Operating control board during an upset condition.	0	1	2	3	4
03080017	Using keyboard for changing control modes.	0	1	2	3	4
03080018	Acknowledging alarms on control board.	0	1	2	3	4
03080019	Switching products technical to liquid.	0	1	2	3	4
03080020	Switching products liquid to technical.	0	1	2	3	4
03080028	Restarting CATV after interlocks down.	0	1	2	3	4
03080030	Operating crossover valve on CC/Toluene tanks.	0	1	2	3	4
03080036	Controlling the Tol at the RX's.	0	1	2	3	4
03080048	Establishing slurry or water flows to the dynomills.	0	1	2	3	4
03080049	Switching dynomills forward to 621-F, 631-F, and back to 612-F.	0	1	2	3	4
03080050	Shutting down spray dryer on water.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX E: TRANSFER QUESTIONNAIRES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Questionnaire
HCN/Sequestrene

Employee name ____________________ Shift _____

As you read each procedure listed below, think about all of the times you have observed the employee named above perform that procedure. Of these times, estimate the percentage of times the employee has completed the procedure exactly as it is written in CATS. Copies of the procedures are attached for you reference if needed. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
01030001.01	Making rounds in the Synthesis area.	0	1	2	3	4
01040027.00	Making rounds in the WGB area.	0	1	2	3	4
01090001.00	Making rounds in the HCN/Sequestrene tank farm.	0	1	2	3	4
01040002.01	Sampling the HCN enricher.	0	1	2	3	4
01040056.00	Sampling the HCN storage tanks..	0	1	2	3	4
01030037.00	Ammonia/HCN recovery boilout.	0	1	2	3	4
01030021.01	Checking the ignitor probe.	0	1	2	3	4
01030051.00	Handling and disposal of ammonia filters.	0	1	2	3	4
01030030.02	Loading/unloading trailers into the phosphate storage tank.	0	1	2	3	4
01030049.00	Refrigeration machine start-up (unit).	0	1	2	3	4
01040012.00	Operating the sulfuric acid system.	0	1	2	3	4
01040028.00	Start-up of the WGB in sequence.	0	1	2	3	4
01070005.00	Loading/unloading from 113-F.	0	1	2	3	4
01070029.00	Sequestrene boilout guidelines.	0	1	2	3	4
01100043.00	Putting ammonia delivery pumps in service.	0	1	2	3	4
01040001.00	Making rounds in the HCN recovery area.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Questionnaire
HCN/Sequestrene Tank Farm

Employee name ____________________ Shift ____

As you read each procedure listed below, think about all of the times you have observed the employee named above perform that procedure. Of these times, estimate the percentage of times the employee has completed the procedure exactly as it is written in CATS. Copies of the procedures are attached for you reference if needed. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
01090002	Raw material sump 29208-A.	0	1	2	3	4
01090003	Formaldehyde truck unloading.	0	1	2	3	4
01090004	EDA truck unloading.	0	1	2	3	4
01090006	DETA truck unloading.	0	1	2	3	4
01090007	AEEA truck unloading.	0	1	2	3	4
01090008	Formaldehyde rail car unloading.	0	1	2	3	4
01090013	HCN rail car water washing and orbijetting	0	1	2	3	4
01090014	HCN rail car loading.	0	1	2	3	4
01090015	HCN rail car acid washing.	0	1	2	3	4
01090016	HCN rail car unloading.	0	1	2	3	4
01090017	Transporting HCN by highway.	0	1	2	3	4
01090019	HCN tank (2101-FB) preparation for inspection.	0	1	2	3	4
01090024	Phosphoric acid unloading.	0	1	2	3	4
01090031	EDA direct from tank truck to unit.	0	1	2	3	4
01090033	HCN tank farm sump system.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Questionnaire
HCN/Atrazine- Ammonia Tank Farm

Employee name ____________________ Shift _____

As you read each procedure listed below, think about all of the times you have observed the employee named above perform that procedure. Of these times, estimate the percentage of times the employee has completed the procedure exactly as it is written in CATS. Copies of the procedures are attached for you reference if needed. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
01100001	Rail car and cargo tank inspections.	0	1	2	3	4
01100011	Unloading toluene from tank trucks.	0	1	2	3	4
01100012	Unloading TBA from tank trucks.	0	1	2	3	4
01100013	Unloading TBA from rail car.	0	1	2	3	4
01100026	Preparation of rail cars for vessel entry.	0	1	2	3	4
01100027	MEA/IPA sampling.	0	1	2	3	4
01100029	Operating the deluge system.	0	1	2	3	4
01100031	Taking inventory readings.	0	1	2	3	4
01100033	Transferring MEA/IPA by pipeline.	0	1	2	3	4
01100036	Decontamination of tank farm vessels (MEA/IPA, TBA).	0	1	2	3	4
01100037	Preparing the ammonia compressors for oil change.	0	1	2	3	4
01100039	Ammonia rail car unloading.	0	1	2	3	4
01100040	Changing the relief valves on the ammonia storage tanks.	0	1	2	3	4
01100042	Amine system inspection.	0	1	2	3	4
01100043	Putting ammonia delivery pumps in service.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Questionnaire
HPF/CC

Employee name ____________________ Shift ______________

As you read each procedure listed below, think about all of the times you have observed the employee named above perform that procedure. Of these times, estimate the percentage of times the employee has performed the procedure exactly as it is written in the CATS. Copies of the procedures are attached for your reference if needed. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time   1 - about 25% of the time   2 - about 50% of the time
3 - about 75% of the time   4 - 100% of the time

Procedure #	Procedure Description					
020C0001	Starting up a CNCL train.	0	1	2	3	4
020C0002	CNCL train shutdown.	0	1	2	3	4
020C0003	CNCL train emergency shutdown.	0	1	2	3	4
020C0058	Pulling molten CC samples.	0	1	2	3	4
020B0009	Starting up and shutting down the topping still.	0	1	2	3	4
020B0026	Starting up transfer colunm and placing recovery area on hot circulation.	0	1	2	3	4
020B0027	Shutting down transfer colunm and recovery.	0	1	2	3	4
020A0001	Starting up a CNCL train.	0	1	2	3	4
020A0002	Shutting down an CNCL train.	0	1	2	3	4
020A0010	Monitoring the control board.	0	1	2	3	4
020A0011	Increasing and decreasing HCN rates on a CNCL train.	0	1	2	3	4
020A0013	Setting CL2 and water flows to CNCL gen for HCN rate.	0	1	2	3	4
020A0015	Troubleshooting a pressure problem on CNCL train.	0	1	2	3	4
020A0022	Nitrogen purging from train through the tail gas absorber and CL dissolver.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
020A0023	Heating up and cooling down trimerizers.	0	1	2	3	4
020A0025	Balancing brine flows.	0	1	2	3	4
020A0039	Monitoring levels in distilled, 130-FA, and 130-FB.	0	1	2	3	4
020A0042	Swapping final dryers.	0	1	2	3	4
020A0051	Starting up and shutting down topping still.	0	1	2	3	4
020A0052	Points to monitor and action steps if reactor or stripper analyzers are not functioning.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transfer Questionnaire
HPF/Atrazine

Employee name ____________________ Shift ________

As you read each procedure listed below, think about all of the times that you have observed the employee named above perform that procedure. Of these times, estimate the percentage of times the employee has completed the procedure exactly as it is written in the CATS. Copies of the procedures are attached for your reference if needed. Use the scale below and your best judgement to circle the number (0,1, 2, 3, or 4) that most closely reflects your estimate.

0 - None of the time 1 - about 25% of the time 2 - about 50% of the time
3 - about 75% of the time 4 - 100% of the time

Procedure #	Procedure Description					
03040005	Operating stripper mod with the evaporator.	0	1	2	3	4
03040006	Unplugging the stripper bottoms pumps.	0	1	2	3	4
03040014	Filter/repulper operation for producing 9-0, basimix, and technical triazine.	0	1	2	3	4
03050003	Formulating base mix for bicep/bicep lite.	0	1	2	3	4
03050004	Formulating Aatrex 4L and Princep 4L.	0	1	2	3	4
03050011	Operating the dynomills.	0	1	2	3	4
03070002	Spray dryer startup.	0	1	2	3	4
03070039	Activating and deactivating total system. Monitoring control board.	0	1	2	3	4
03080001	Monitoring control board.	0	1	2	3	4
03080004	Setting ratios and changing ratios.	0	1	2	3	4
03080005	Starting spray dryer.	0	1	2	3	4
03080007	Run computer programs for formulations. Operator).	0	1	2	3	4
		0	1	2	3	4
03080008	Adjusting Ph on formulated batches.					
03080012	Operating control board during an upset condition.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedure #	Procedure Description					
03080014	Changing rates on reactors.	0	1	2	3	4
03080017	Using keyboard for changing control modes.	0	1	2	3	4
03080018	Acknowledging alarms on control board.	0	1	2	3	4
03080019	Switching products technical to liquid.	0	1	2	3	4
03080028	Restarting CATV after interlocks down.	0	1	2	3	4
03080048	Establishing slurry or water flows to the dynomills.	0	1	2	3	4

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX F: STANDARD OPERATING PROCEDURES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

HCN & HPF
Standard Operating Procedures

HCN Synthesis/Ammonia Recovery Area	
Making rounds in Synthesis and Ammonia recovery area.	01030001
HCN flame arrestors cleaning and draining.	01030002
Blowing down the sludge in blowdown vaporizer.	01030003
Lining up the converter for startup.	01030004
Putting converter into the process.	01030005
Starting up the Elliott air compressor.	01030006
Advancing the air filter on the Elliott air compressor.	01030007
Checking the level interlock on the waste heat boiler.	01030008
Preparing the converter cone for maintenance.	01030009
Sweetening the catalyst for the converter.	01030010
Switching the Elliott air compressor oil filters and changing them.	01030011
Switching the mixed gas filters for change out.	01030012
Putting the ammonia steam vaporizer on/off line.	01030013
Putting the methanol vaporizer on/off line.	01030014
Putting the ammonia blowdown vaporizer on/off line.	01030015
Draining the ammonia flare knockout pot.	01030016
Blowing sown the MEOH/H2O ammonia vaporizer.	01030017
Blowing down the hot gas cooler.	01030018
Taking the converter natural gas filter out of service.	01030019
Flaring the converter.	01030020
Checking the ignitor probe.	01030021
Lighting the unit flare with the flame from generator.	01030022
Operating the hoist for the converter and HCN tank farm.	01030024
Pressure testing the air superheater.	01030025
Pressure testing the mixed gas superheater.	01030026
Nitrogen pressure testing the converter.	01030027
Flushing and changing out phosphate filters.	01030029
Loading/unloading trailers into the phosphate storage tank.	01030030
Switching ammonia storage tanks.	01030031
Adding liquid ammonia to the 36" line going to the ammonia absorber.	01030032
Lining up the ammonia line from the sequestrene unit to the ammonia storage tanks.	01030033
Switching the ammonia recycle.	01030034
Start-up/shut-down happy fans.	01030035
Adding antifoam to the ammonia enricher.	01030036
Ammonia/HCN recovery boilout.	01030037
Preparing ammonia phosphate.	01030038
Nitrogen bumping the cooling water heat exchangers.	01030039
Adding phosphoric acid to the ammonia absorber.	01030040
Caustic washing the ammonia recovery.	01030041
Neutralizing the caustic wash material.	01030042
Lining up the ammonia stripper mid stream exchangers.	01030043
Lining up the ammonia stripper bottoms exchangers.	01030044
Unplugging the cooling water exchangers in the ammonia recovery.	01030045

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Use of the phosphate storage tank.	01030046
Sampling the ammonia recovery filters.	01030047
Nitrogen pressure testing the ammonia recovery area.	01030048
Refrigeration machine start-up.	01030049
Transfer of methanol from drums to the methanol storage tank.	01030050
Handling and disposal of the ammonia filters.	01030051
Pressure testing the off gas cooler (3003-C).	01030052
Pressure testing the NH3 preheaters.	01030053
Pressure testing the waste heat boiler.	01030054
Caustic make-up for cleaning HCN flame arrestors.	01030056
Analyzing ammonia recovery samples.	01030057
Analyzing eh converter samples.	01030058
NH3 enricher overhead pot venting.	01030059
Switching converter from process to flare an shutdown.	01030060
Isolating a refrigeration machine in the HCN unit for maintenance.	01030061
HCN Recovery/WGB Area	
Making rounds in the HCN recovery area.	01040001
Sampling HCN enricher.	01040002
Adding antifoam and copper sulfate to the HCN recovery system.	01040004
Replacing sulfuric acid filters.	01040005
Switching sulfur dioxide cylinders.	01040006
Establishing and maintaining proper sulfur dioxide flows.	01040007
HCN rework to the HCN absorber.	01040008
Putting the aqueous purge stripper in/out service.	01040009
Flushing the Ph probes on the packed cooler.	01040011
Operating her sulfuric acid system.	01040012
Putting the HCN stripper reboiler in service.	01040013
Putting the blowdown pot to the aqueous purge stripper.	01040014
Shedding steam load from HCN stripper & aqueous purge stripper.	01040015
Flushing Ph probes on the HCN absorber.	01040016
Back flushing the acid spray filters.	01040017
Unplugging the HCN enricher acid spray rotameters.	01040018
Caustic washing eh HCN recovery area.	01040019
Neutralizing the HCN recovery train.	01040020
Neutralizing the packed cooler.	01040021
Setting up the process to process exchangers for maintenance.	01040022
RE-establishing her seal leg on the HCN absorber.	01040023
Nitrogen to the HCN striper for vacuum control.	01040024
HCN recovery acidity control.	01040025
Analyzing the HCN recovery area samples.	01040026
Making rounds in the waste gas boiler area.	01040027
Start-up of the waste gas boiler in sequence.	01040028
Isolating the steam headers from the rest of the plant.	01040029
Putting the converter off gas cooler boiler feed water in service.	01040030
Adjusting main by-pass natural gas regulator to waste gas boiler.	01040031
Purging the north and south level pots on the waste gas boiler.	01040032
Slow rolling the steam turbine.	01040033
Waste gas boiler electric feed water pump start-up.	01040035
Waste heat/waste gas boiler chemical make up.	01040036
Hydrostatic testing of the waste gas boiler.	01040037

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Analyzing the waste gas boiler samples.	01040038
Operation of the 600/50# letdown steam stations.	01040039
Shutdown of the 175# flash tank.	01040040
Shutdown of the seal flash tank.	01040041
Shutdown of the 50# flash tank.	01040042
Shutdown of the 600# flash tank.	01040043
Operation of the 50# steam header isolation valve.	01040044
Handling and disposal of acid spray filters.	01040045
SO2 cylinder identity check.	01040046
Nitrogen pressure testing HCN recovery.	01040047
Slugging the packed cooler from the sulfuric acid day tank.	01040048
Slugging the packed cooler from sulfuric acid storage tank (2128-F).	01040049
Filling the sulfuric acid day tank (1400-19).	01040050
Metering acid to HCN enricher and packed cooler.	01040051
Slugging the HCN enricher with sulfuric acid.	01040052
Sulfuric acid to the sequestrene unit vent scrubber.	01040053
Adding sulfuric acid to HCN storage tanks.	01040054
Sampling the HCN storage tanks.	01040056
Analyzing the HCN unit process streams.	01040057
HCN transfer from tank to tank in HCN tank farm.	01040058
Venting gas from process to process exchanger to HCN stripper.	01040059
Action taken during loss of weak acid flow to HCN recovery.	01040063
HCN Control Board	
Use of the control board keyboard and screen.	01050001
Normal loop settings and control actions for variations.	01050002
Emergency tape recorder and the use of the red emergency phone.	01050003
Stroking a control valve inside and outside.	01050004
Slugging the packed cooler with sulfuric acid.	01050005
Generating inventory/production report.	01050006
Starting up the HCN unit from the control board.	01050007
Operating the statox instrumentation.	01050008
Use of the emergency air station.	01050009
Plotting converter start-up samples.	01050010
Controlling waste gas boiler steam rate during converter upset.	01050011
Actions taken during steam failure.	01050013
Actions taken during electrical failure.	01050014
Actions taken during air failure.	01050015
Actions taken during computer failure.	01050016
Actions taken during nitrogen failure.	01050017
Testing the emergency alert system.	01050018
Use of the emergency plant wide PA system.	01050019
Actions taken during cooling water failure.	01050020
Actions taken during treated water failure.	01050021
HCN converter interlocks.	01050022
HCN Sequestrene Unit	
Sequestrene pre-start procedure.	01060003
Making rounds.	01070001
Sampling sequestrene from pumps.	01070002
Start-up/shutdown of sequestrene pumps.	01070003

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Transferring 30AQ to 30A tanks.	01070006
Transferring 302FA to FB and FB to FA.	01070007
Reworking samples into the rework pot.	01070010
Operating the Christmas tree manifold.	01070011
Pumping up hydrogen peroxide.	01070012
Switching out hydrogen peroxide tote tank.	01070013
Unloading from 111-F into tank trucks.	01070014
Flushing the formaldehyde flow meters.	01070015
Calibrating the ammonia and HCN analyzers.	01070016
Filling an order for sequestrene sample stock.	01070018
Lighting the HCN drop tank flare.	01070020
Unloading aqueous ammonia.	01070021
Operation of the halon system in the lab.	01070022
Decontaminating the ammonia purification column.	01070023
HCN/Sequestrene laboratory waste disposal.	01070024
Handling and disposal of sequestrene filter socks.	01070025
Analyzing samples in the sequestrene area.	01070026
Setting up HCHO filter for cleaning.	01070027
Decontamination of reactors.	01070028
Sequestrene boilout guidelines.	01070029
Preventing /checking N2 bottles for process contamination.	01070030
Transferring solution to the process form tank trucks.	01070031
Required personal protective equipment of sequestrene samples.	01070032
Critical equipment in the sequestrene unit.	01070033
Methanol column operation.	01070034
Sequestrene Truck Loader	
Loading sequestrene 30-AQ solution into tank trucks.	01080001
Loading sequestrene DTPA-41 solution into rail cars.	01080002
Loading sequestrene tank trucks from railcars.	01080003
Loading DTPA-41 solution into tank truck.	01080004
Loading sequestrene 30-A solution into tank trucks.	01080005
Loading DM-41 solution into tank truck.	01080006
Loading sequestrene 30-AQ into rail car.	01080007
Loading sequestrene 30-A solution into rail car.	01080008
Loading DM-41 rail cars.	01080009
HCN/Sequestrene Tank Farm	
Making rounds in HCN/Sequestrene tank farm.	01090001
Raw material sump 29208-A.	01090002
Formaldehyde truck unloading.	01090003
EDA truck unloading.	01090004
Decontamination of formaldehyde tank for vessel entry.	01090005
DETA truck unloading.	01090006
AEEA truck unloading.	01090007
Formaldehyde railcar unloading.	01090008
Handling an HCN railcar with dark material, high temp. & pressure.	01090010
Cleaning the sulfuric acid tank sight glass.	01090011
Refrigeration machine start-up/shutdown.	01090012
HCN railcar water washing and orbijetting.	01090013

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

HCN railcar loading.	01090014
HCN railcar acid washing.	01090015
HCN railcar unloading.	01090016
Transporting HCN by highway.	01090017
External preparation of railcar for inspection.	01090018
HCN tank (2101-FB) preparation for inspection.	01090019
Sulfuric acid cargo tank unloading.	01090020
Rupture testing HCN hoses.	01090021
Operating the trackmobile.	01090023
Phosphoric acid unloading.	01090024
Vessel entry on HCN tank car.	01090025
Filling drums from the phosphoric acid storage tank.	01090026
Pumping out the acid storage tank dike.	01090027
Operating the hoist.	01090028
EDA direct from tank truck to unit.	01090031
Tank inspection procedure 2101-FA.	01090032
HCN tank farm sump system'	01090033
Sequestrene railcar orbijetting.	01090034
HCN tank (2130-F) preparation for inspection.	01090035
HCN/SEQ tank farm checklist.	01090036
HCN Atrazine/Ammonia Tank Farm	
Making rounds.	01100001
Rail car and cargo tank inspections.	01100003
Unloading renex from tank trucks.	01100004
Unloading igepon from tank trucks.	01100005
Unloading ethylene glycol form tank trucks.	01100006
Unloading polyfon from tank trucks.	01100007
Unloading sorbit from tank trucks.	01100008
Unloading witconate from tank trucks.	01100009
Unloading glycerine from tank trucks.	01100010
Unloading toluene from tank trucks.	01100011
Unloading TBA from tank trucks.	01100012
Unloading TBA from rail car.	01100013
Unloading polyfon from rail car.	01100014
Unloading sorbit from rail car.	01100015
Unloading ethylene glycol from rail car.	01100016
Unloading P65 (Toximul) from rail car.	01100017
Unloading renex from rail car.	01100018
Unloading igepon from rail car.	01100019
Loading 4-L rail cars.	01100020
Off-loading 4-L rail cars.	01100023
Perparation of rail cars for vessel entry.	01100026
MEA/IPA sampling.	01100027
Cargo tank and rail car soampling of liquid herbicides.	01100028
Operating rthe deluge system.	01100029
Cleaning rthe 4-L load lines at the end of a campaign.	01100030
Taking inventory readings.	01100031
Orbijetting 4-L cars.	01100032
Transferring MEA/IPA by pipeline.	01100033
Makiing masterbatch for 4-L.	01100034
Making masterbatch for Princep.	01100035
Decontamination of tank farm vessels.	01100036

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Ammonia rail car unloading.	01100039
Changing the relief valves ont eh ammonia stroage tanks.	01100040
Product identity check of ammonia rail cars.	01100041
Amine system inspection.	01100042
Putting ammonia delivery pumps in service.	01100043
Ammonia rail car loading.	01100044
Atz/NH3 tank farm freeze protection checklist.	01100045
HPF/Atrazine Reactor Area Procedures	
Start up of dichloro and triazine reactors for technical atrazine.	03030001
Start up of dichloro and triazine reactors for prpazine.	03030002
Start up of dichloro and triazine reactors for simazine.	03030003
Start up of dichloro and triazine reactors for GS-13529.	03030004
Check out dichloro and atrizine multi-stage reactors for start up.	03030005
Water flushing the dichloro and triazine reactors.	03030006
Toluene flushing the dichloro and triazine reactors.	03030007
Sampling the 1st dichloro and 2nd dichloro reactors for ph.	03030008
Pumping the vent relief tank.	03030009
Swapping the dichloro pumps 143J and 143JA.	03030010
Swapping the CC/Toluene strainers and cleaning.	03030011
By-passing a triazine reactor.	03030012
Flushing the 1st stage dichloro cooler on line.	03030013
Shutting sown dichloro triazine reactors normal, emergency.	03030014
Flushing the caustic analyzer.	03030015
Operating hoist on reactor deck.	03030016
Evacuating dichloro cooler for maintenance.	03030017
Setting up MEA cooler for maintenance.	03030018
Setting up dichloro piping for maintenance.	03030019
Setting up dichloro reactors for maintanance and vessel entry.	03030020
Setting up atrazine multi-stage for removal of agitator.	03030021
Washing down dichloro reactor deck.	03030023
Opening dichloro and triazine reactors for inspection.	03030024
Sampling procedure for caustic.	03030026
Statr up procedure for caustic dilution.	03030027
Check out & line up of dichloro & triazine reactors for simazine run.	03030028
Prepare CC/Toluene meters for removal.	03030029
Dumping reactor samples in the sample dump station.	03030030
By-pass tris/dichloro analyzer for maintanance.	03030031
Seting up 171-J for maintanance.	03030032
Calibrating ph meters in the 102-K lab.	03030033
Setting up triazine reactors for maintenance and for vessel entry.	03030034
Check out triazine reactors for start up from the 1st through the 3rd triazine Rx.	03030035
Water flushing the simazine reactors.	03030036
Toluene flushing the simazine reactors.	03030037
Preparing atrazine samples for injection to obtain analysis.	03030038
Preparing propazine technical for injection ot obtain analysis.	03030039
Preparing turbutylazine GS-13529 for injection to obtain analysis.	03030040
Preparing simazine technical for injection to obtain analysis.	03030041

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

HPF/Atrazine Filter Area Procedures	
Start up of stripper filter area without striper mod.	03040001
Lining up of stripper filter with stripper modification area on line.	03040002
Toluene flushing and start up of the stripper filter area using stripper mod.	03040003
Starting up of stripper filter area without using stripper mod.	03040004
Operating stripper mod with the evaporator.	03040005
Unplugging the stripper bottom pumps.	03040006
Start up of rotary drum filter.	03040007
Start up of the primary and secondary stripper.	03040008
Adjusting filter cloth on rotary drum filter.	03040009
Making up dilute acid for rotary drum filter cloth and scavenger filter wash.	03040010
Acid washing the rotary drum filter cloth and scavenger filter cloth.	03040011
Sluicing scavenger filters.	03040012
Making up surfactant batches with polyfon and sorbit.	03040013
Filter/repulper operation for producing 9-0, base mix, and technical triazine.	03040014
Taking a stripper overhead condenser off-line; also steaming the overhead.	03040015
Shutdown of stripper filter area without stripper mod.	03040016
Shutdown of stripper filter area including stripper mod.	03040017
Unloading sulfuric acid.	03040018
Setting up scavenger filter for maintenance.	03040019
Switching radar drum filters and setting up rotary drum filter for maintenance.	03040020
Setting up the evaporator for blinding to be steamed.	03040021
Setting up the slurry strippers for inspection and maintenance.	03040022
Setting up stripper feed tanks for PM of safety devices.	03040023
Unplugging circulation pump line on slurry stripper.	03040024
Setting up stripper area piping for maintenance.	03040025
Lining up caustic to stripper feed tanks and stripper for ph adjustment.	03040026
Setting up 186-C for maintenance.	03040027
Reworking CC/toluene and toluene into stripper feed tanks from white goose.	03040028
Swapping siefer screens for cleaning.	03040029
Setting up vent blower on rotary drum filter for maintenance.	03040030
Setting up repulper for maintenance.	03040031
Dumping igepon at the repulper.	03040032
Pumping sluice water dike to sluice tank.	03040033
Making rounds of the stripper filter area.	03040034
Pre-start up check after extended shutdown.	03040035
Swapping vacuum pumps.	03040036
Cleaning filter on feed line to waste water tank.	03040037
Cleaning filter on feed line to waste water tank.	03040038
Toluene flushing 199 and 123 pumps.	03040039
Unload ammonia soap.	03040040
Toluene flushing the stripper feed tank pumps.	03040041

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Dumping condensate from condensate tank.	03040042
Using 1011J to pump to north stripper feed tanks.	03040043
Setting up steam injector on stripper mod.	03040044
Setting up condensate tank condenser 168-C for maintenance.	03040045
Setting up 198J for maintenance.	03040046
Setting up north vacuum pump for maintenance.	03040047
Lining up drewperse pumps.	03040048
Sampling in the stripper filter.	03040049
Switching from the rag layer pump to the toluene pump suction.	03040050
Flushing stripper feed tank rotor meter.	03040051
Lining up overhead condenser for primary and secondary stripper.	03040052
Start up of the repulper.	03040053
Use of ammonia soap station.	03040054
By-pass around rotary drum filters.	03040055
Unloading ammonia soap ADX.	03040056
Setting up rotary drum filters for maintenance to clean spray bars.	03040057
<u>HPF/Atrazine Formulation Area Procedures</u>	
Aatrex Nine-O and caliber Nine-O feed stock.	03050001
Setting up ball mill coolers for maintenance.	03050002
Formulating base mix for Bicep/Bicep lite.	03050003
Formulating Aatrex 4-L and Princep 4-L.	03050004
Operating portable platform in triazine unit.	03050005
Making up bum arabic solution for formulating Aatrex Nine-O and Caliber Nine-O.	03050006
Unloading proxel from tank truck into storage.	03050007
Transferring proxel from main storage to unit storage tank.	03050008
Making up pregel for flowable products.	03050009
Making rounds in the formulations area.	03050010
Operating the dyno mills.	03050011
Transferring batches from one trim tank to another trim tank.	03050012
Adjusting ph on formulated batches.	03050013
Adding anti-foam to slurry batches.	03050014
Transferring 4-L batches to silos.	03050015
Pumping water form the formulation area sump to the waste water tank or trim tank.	03050016
Pre-start up check out of formulation area after extended shutdown.	03050017
Swapping blinds on amines tank suction and discharge line for triazine products.	03050018
Pumping rag and water layer from raw toluene tank to toluene/water separator.	03050019
Processing surfactant free technical.	03050020
Draining dikes in TRZ tank farm.	03050021
Setting up 40 pumps for maintenance.	03050022
Swapping master batch tanks.	03050023
Bringing Nino-O reslurry from packaging.	03050024
Isolating and setting up a formulation trim tank for maintenance.	03050025
Setting up a dyno mill for maintenance.	03050026
Adding beads to a dyno mill.	03050027
Pulling and cleaning screens on dyno mill sieve chanber and exit line filter pot.	03050028
Emergency shutdown - formulations area.	03050029

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Setting up CC/toluene line for maintenance.	03050031
CC/toluene loading station.	03050032
Lining up 606 sump to rotary drum filter or #1 sump.	03050033
Circulating a batch of material.	03050034
Starting up CATV with used carbon.	03050035
Setting up 193-F knock out pot for maintenance.	03050036
Setting up 193C1 chiller for maintenance.	03050037
Lining up 193-C1 chiller for start-up.	03050038
Lining 193-F knock out pot for start-up.	03050039
Lining up 193-C1, 192-F, 191-J, and 193-J for start-up.	03050040
Setting up 192-F toluene/water drum.	03050041
Setting up 194-J blower.	03050042
Setting up 193-C2 for maintenance.	03050043
Setting up 194-FA and FB carbon vessels for maintenance.	03050044
Setting up 2414-FJ1 for maintenance.	03050045
Starting up 2414-FJ1 blower at effluent day tank.	03050046
Preparation for start up for CATV.	03050047
Steaming newly charged CATV absorber beds to lower activity of virgin carbon.	03050048
Manually purging absorber with nitrogen after a temperature interlock.	03050049
Manually advancing an absorber to another phase.	03050050
Making rounds in the CATV area.	03050051
Unloading proxel BXL form tank trailer to 175-F.	03050052
Liquid formulations filtration test procedure.	03050053
Setting up surfactant piping from tank farm to unit for technical and 9-0 production.	03050054
Setting up replacement of CATV absorber rupture disc.	03050055
<u>HPF/Atrazine Spray Dryer Area Procedures</u>	
Check out and line up spray dryer and related equipment for start up.	03070001
Spray dryer start up.	03070002
Atomizer start up.	03070003
Lighting spray dryer furnace.	03070004
Sampling in the spray dryer area.	03070005
How to make a round in the spray dryer area.	03070006
Lining up nitrogen or inert gas.	03070007
Operating pulse air system to baghouse.	03070008
Swapping baghouses on the spray dryer and feeding out powder.	03070009
Cleaning hats on aftergrinder millhead.	03070010
Adding oil to oil mist system on aftergrinder millhead and blower.	03070011
Checking aftergrinder baghouses for down bags.	03070012
Unplugging cone on the bottom of the spray dryer.	03070013
Swapping screens on wet scrubber, steps for purging-maintaining brushsifters, swapping barrels.	03070014
Maintaining brushsifters, swapping barrels, etc.	03070015
Cleaning screens on spray dryer feed pump and magnetic filter.	03070016
Switching trim tank feeding spray dryer feed tank.	03070017
Operating and cleaning a sweco.	03070018
Setting up aftergrinder for maintenance.	03070019
Setting up a double airlock for maintenance to remove.	03070020

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Defeating denwal interlock on an aftergrinder system for test run.	03070022
Setting up a powder transfer blower for maintenance.	03070023
Shutting down the spray dryer for lack of feed.	03070024
Shutting sown the spray dryer for maintenance.	03070025
Cleaning temperature probe on the spray dryer exit.	03070026
Switching powder silos.	03070027
Setting up to flush atomizer lube oil cooler with rydlyme.	03070028
Shutting down spray dryer and aftergrinder.	03070029
Starting up and shutting down an aftergrinder system.	03070031
Rodding out nozzle on wet scrubber.	03070032
Cleaning out aftergrinder wet scrubber.	03070033
Setting up inert cooler for maintenance.	03070034
Starting up the ribbon blender.	03070035
Bypass fenwall interlock for B double airlock.	03070036
Checking aftergrinder baghouse pulse air system.	03070037
Checking spray dryer baghouse pulse air system.	03070038
Activating and deactivating total system.	03070039
Activating and deactivating rapid acting valve.	03070040
Spray dryer deluge system.	03070041
Removing and installing total bottles.	03070042
<u>HPF/Atrazine Area Control Board Procedures</u>	
Monitoring control board.	03080001
Starting up caustic dilution.	03080002
Starting up dichloro/triazine area.	03080003
Setting ratios and changing ratios.	03080004
Starting spray dryer.	03080005
Making up a batch of surfactant.	03080006
Run computer programs for formulations.	03080007
Changing rates on reactors.	03080008
Heating up primary stripper and establishing flows.	03080010
Feeding masterbatch to 4-L and 6-L formulation.	03080011
Adjusting ph in formulation batches.	03080012
Activating deluge system on spray dryer from control board.	03080013
Operating the control board during an upset condition.	03080014
Toluene flushing reactors./stripper filter/establish flows.	03080015
Stroking control valve.	03080016
Using key board for changing control modes.	03080017
Acknowledging alarms on control board.	03080018
Switching products technical to liquid at repulper.	03080019
Switching products liquids to technical at repulper.	03080020
Heating up the evaporator.	03080021
Start up of rotary drum filter and sluice water tank system.	03080022
Emergency shutdown due to steam failure.	03080023
Emergency shutdown due to electrical failure.	03080024
Emergency shutdown due to plant air failure.	03080025
Flushing rotor meters on stripper feed tanks.	03080026
Start up of CATV.	03080027
Restarting CATV after interlocks shutdown.	03080028
Shutdown CATV.	03080029
Operating crossover valve on CC/toluene tanks.	03080030
Calculate igepon additions after reactor start up.	03080031
Activating silo halon system.	03080032

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Heating up secondary stripper and establishing flows.	03080033
Shutting sown caustic dilution.	03080034
Shutting down the reactors for product changeover after product campaigns.	03080035
Controlling the TOC at the reactors.	03080036
Toluene flushing the reactors for a simazine campaign.	03080037
Switching CC/toluene flow meters.	03080038
Water flushing the reactors for a simazine campaign.	03080039
Water flushing the reactors for atrazine, propazine, and GS-13529 campaign.	03080040
Start up reactors for simazine campaign.	03080041
Start up reactors for propazine campaign.	03080042
Start up reactors for GS-13529 campaign.	03080043
Taking the evaporator out of service and toluene flushing it.	03080044
Taking a stripper overhead condenser off line.	03080045
Putting effluent day tank in service.	03080046
Action taken during an inversion of the toluene water separator.	03080047
Establishing slurry or water flows to the dyno mills.	03080048
Switching dyno mills forward to 621-F, 631-F, and back to 612-F.	03080049
Shutting down spray dryer on water.	03080050
Tracing downtime on CATV point source equipment for the HPF/TRZ area.	03080051
HPF/CC 'A" Area Control Board Procedures	
Starting up a CNCL train.	020A0001
Shutting down a CNCL train.	020A0002
Steps to take in the event of a power failure.	020A0003
Cold circulating recovery area.	020A0004
Hot circulating recovery area.	020A0005
Balancing CC14 flows in the recovery area.	020A0006
Starting up and shutting down the transfer column.	020A0007
Heating up and cooling the dowtherm system and trimerizers.	020A0008
Clearing entire C12 system from pioneer fence to CC area and ET block valve.	020A0009
Monitoring the control board.	020A0010
Increasing and decreasing HCN rates on a CNCL train.	020A0011
Calculating and setting toluene flows for a given HCN rate.	020A0012
Setting C12 and water flows to a CNCL generator for a given HCN rate.	020A0013
Starting up and shutting down a CNCL compressor.	020A0014
Troubleshooting a pressure problem on a CNCL train.	020A0015
Pumping up HCN drop tanks.	020A0016
Starting and feeding HCN wash water to a CNCL train.	020A0017
Shutting down and securing CNCL reactors without outside technicians.	020A0018
Handling C12 liquid and vapor leaks in CC area.	020A0019
Switching recycle gas.	020A0020
Vent gas combustor start up and shutdown.	020A0021
Nitrogen purging from trains through the tail gas absorber and CC dissolver.	020A0022
Heating up and cooling down trimerizers.	020A0023

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Heating up 124F.	020A0024
Balancing brine flows.	020A0025
Switching caustic scrubber blowers.	020A0026
Shutting down York refrigeration machines from board.	020A0027
Switching pressure transmitters on 106-F to 114-F.	020A0028
Raising and lowering 270 pound and 100 pound or 150 pound steam headers.	020A0029
Troubleshooting temperature problem on hot oil.	020A0030
Troubleshooting pressure problems on 117F.	020A0031
Breaking CC dissolver cascade loop and why.	020A0032
Unplugging 106C CD dissolver recycle cooler.	020A0033
Switching HCN, C12, and water meters on CNCL reactors.	020A0034
Switching level indication on CC dissolver.	020A0035
Transferring CC14 from 131FR and back from system.	020A0037
Switching CCL4 guard dryer chamber.	020A0038
Monitoring levels in req, distilled, 130FA, and 130FB.	020A0039
Acid washing the scrubber on the vent gas combuster.	020A0040
Troubleshooting high CC concentration in CC14 stream.	020A0041
Swapping final dryers.	020A0042
Switching CNCL reactor and HCl stripper pumps.	020A0043
Trapping nitrogen on trimerizers.	020A0044
Taking messages on emergency phone.	020A0045
Announcing emergencies on the plant PA system.	020A0046
Halon system operation for 101-K.	020A0047
Acknowledging emergency alerts.	020A0048
Adding nitrogen to the 130 tanks when pressure in negative or positive.	020A0049
Acknowledging hydrocarbon and HCN toxi-guard alarms.	020A0050
Starting up and shutting down the topping still.	020A0051
Points to monitor and action steps if reactor or stripper analyzer are not functioning.	020A0052
Tracking downtime on CATV point source equipment for the HPF/CC area.	020A0053
Bringing chlorine into the CC area from pioneer.	020A0054
Starting up and running a CNCL train with low concentration HCN.	020A0055
<u>B Area Procedures</u>	
Bypassing 117-C and 114-F on wash column.	020B0001
CC14 cold circulation of recovery bypassing the transfer column.	020B0002
Setting up the tail gas absorber for washing and returning to service.	020B0004
Operating 118-C and 11-CB.	020B0005
Setting up 103-E, CC14 stripper for washing.	020B0006
Washing 104-E transfer column.	020B0007
Setting p CC14 and toluene guard dryer pre and after filters.	020B0008
Starting up and shutting down the topping still.	020B0009
Setting up 140-C topping still overhead condenser for maintenance.	020B0010
Setting up 141-C topping still reboiler for maintenance.	020B0011
Setting up 175-C topping still bottom piggyback for maintenance.	020B0012
Setting up 141-C topping still top piggyback for maintenance.	020B0013

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Operating CC/toluene sample recovery system on 130FA/FB.	020A0014
CC14 guard dryer, switching, regenerating and washing chambers.	020A0015
Setting up toluene feed filters and back wash filters for maintenance.	020A0016
Setting up 159-C topping still overhead drum vent condenser for maintenance.	020A0017
Setting up 139-C topping still bottoms cooler for maintenance.	020A0018
Setting up recovery area pumps for maintenance.	020A0019
Reacting and pumping out 141-F sample rework tank.	020A0020
Transferring CC14 from 131-f to the system.	020A0021
Steaming the CC dissolver and tail gas absorber recycle coolers to unplug.	020A0022
Unloading CC14 from tank truck to 1341-F storage tank.	020A0023
Draining the recovery area dikes.	020A0024
Taking out and placing 128-CA/CB - Cc/toluene tank condenser in service.	020A0025
Starting up transfer column and placing recovery area on hot circulation.	020A0026
Shutting down transfer column and recovery.	020A0027
Internal inspection of the transfer column.	020A0028
Operating the foam system of CC/toluene tanks.	020A0029
Sampling for CC concentration in CC disolver.	020A0030
Placing 176-F CC dissolver vent relief tank in service.	020A0031
Pinpointing water leaks into recovery area.	020A0032
Placing 150 pound steam system in service.	020A0034
Setting up CC/toluene tanks to change rupture discs or maintenance on water scrubbers.	020A0035
Charging chilled toluene tank 2104-F.	020A0036
Making rounds in B area.	020A0037
B area samples.	020A0038
Steps to take in B area in the event of a power failure.	020A0039
Taking freeze precautions in B area.	020A0040
Taking readings in B area.	020A0041
Cleaning up and de-inventorying recovery area in preparation for washing.	020A0042
Going above first level in recovery area on top 130FA/FB.	020A0043
Adding nitrogen to 130FA and 130-FB or depressuring.	020B0044
Draining acid from 107-C for maintenance.	020B0045
Setting up CC dissolver for maintenance.	020B0046
Setting up 107-C for maintenance.	020B0047
Washing toluene feed and backwash filters.	020B0048
C Area - CNCL & CC Reaction	
Starting up CNCL train.	020C0001
CNCL train shutdown.	020C0002
CNCL train emergency shutdown.	020C0003
CNCL blower start-up and shutdown.	020C0014
Swapping CNCL final dryers and regenerating.	020C0005
Installing wash out point, washing and blinding on HCN line to CNCL reactor.	020C0006
Operating the dowtherm rework tank	020C0007
Lighting the HCN drop tank flare.	020C0008

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Routine check of HCN drop tank system.	020C0009
Taking a predryer off line for maintenance to recharge or repair.	020C0010
Setting up 120C dowtherm vent condenser.	020C0011
Sampling the CNCL generator bottoms for ammonium chloride.	020C0012
Washing 1-1 repeaters on reactors CNCL and HCL strippers.	020C0013
Switching 127-J or 127JAT hot oil pumps and setting up for maintenance.	020C0014
Switching 115-J and 115-JAT dowtherm pumps and setting up for maintenance.	020C0015
Switching and setting up generator and stripper pumps.	020C0016
Dropping back dowtherm from return to 117F into 124F.	020C0017
Pressuring up primary trimerizers with nitrogen.	020C0018
Clearing the trimerizers with nitrogen.	020C0019
Clearing the trimerizers for recharging.	020C0020
Handling C12 liquid and vapor leaks in CC area.	020C0021
Blinding C12 lines.	020C0022
Inspecting and ultrasonic testing of trimerizer.	020C0023
Taking a C12 vap. Out of service and returning it to service after repair.	020C0024
Clearing entire C12 system from pioneer fence to CC area and ET block valve.	020C0025
Liquid leaks on C12 transfer line from pioneer fence to CC area.	020C0026
Pumping 119F to 124 F.	020C0027
Decontaminating the CCN wash water lines to the CNCL reactors.	020C0028
Setting up for removing dowtherm heater 101U relief valve at 119F.	020C0029
Taking freeze precautions in C area.	020C0030
Operating steam supply system in area 6.	020C0031
Drying dowtherm in 124-F.	020C0032
Cooling and heating trimerizers utilizing 124F cooling/heating system.	020C0033
Heating and cooling entire dowtherm system.	020C0034
Pumping 124F to 117F.	020C0035
Setting up 101F, 201F, or 301F C12 surge drums for maintenance.	020C0036
Unloading dowtherm into 124-F.	020C0037
Clearing 183-C dowtherm heater for 124-F and setting up for maintenance.	020C0038
Cleaning 149C dowtherm cooler for 124-F and setting up for maintenance.	020C0039
Cleaning HCN drop tanks for repair/inspection.	020C0040
Sampling dowtherm and hot oil systems.	020C0041
Spent carbon treatment.	020C0042
Draining shells and tube sheets on trimerizers.	020C0043
Setting up 117F for maintenance.	020C0044
Operating roll blinds on final dryers.	020C0045
Checking for liquid CNCL in final dryer inlets and predryer drains.	020C0046
Making rounds in c area.	020C0047
Sampling fro free C12 in CHL stream to ET.	020C0048
Steps to take in C area in the event of a power failure.	020C0050
Locating CNCL leaks in areas 5 and 6.	020C0051
Pinpointing water leaks in CNCL final dryer regeneration system.	020C0052
Clearing CNCL reactor brine exchangers for maintenance.	020C0053

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Removing inserts and water vapor from 117-F.	020C0055
Setting up a CC separator for internal inspecting, removing pluggage and returning it to service.	020C0056 020C0057
Pulling molten CC samples.	020C0058
Making weekly inspections of C12 line from pioneer fence to CC area.	020C0059
Sampling beds in the final dryers.	020C0060
Draining the predryers and unplugging the predryer drain lines.	020C0061
Decanting water from 119F dowtherm blowdown drum.	020C0062
Clearing 121C and 189C hot oil coolers and setting up for maintenance.	020C0063
Setting up the dryer drain tank for cleaning.	020C0064
Checking for HCN leaks in area 5.	020C0065
Setting up CNCL reactor and HCl stripper overhead pressure relief valve for maintenance or to change rupture disc.	020C0066
Opening tripped HCN auto shut off valves on HCN feed line to the reactors at drop tanks.	020C0067
Setting up dowtherm heater 101-U for refractory and tube inspection.	020C0068
Setting up dryer drain pumps common discharge line for maintenance.	020C0069
Setting up 169C to pull relief valve.	020C0070
Handling molten CC leaks in area 6.	020C0071
Taking readings in C area.	020C0072
Switching recycle gas flow to CNCL trains.	020C0073
Setting up 124F for maintenance.	020C0074
Setting up 154-F and 169-C for maintenance.	020C0075
Setting up hot oil condensers for maintenance.	020C0076
Operating C12 emergency shout off valves.	020C0077
Pumping out the dryer drain tank.	020C0078
Bringing chlorine into the CC area from pioneer.	020C0079
Setting CNCL final dryers for recharge.	020C0080
D Area Brine, Caustic, and Vent Gas Combuster	
Switching caustic scrubber circulating tanks.	020D0001
Setting up caustic pumps for maintenance.	020D0002
Switching and setting up 138 caustic scrubber blowers for maintenance.	020D0003
Pumping out a spent caustic tank to ET.	020D0004
A and B York operating procedures.	020D0005
Transferring oil from York to separator and back.	020D0006
Starting up, operating and shutting down C York.	020D0007
Unloading brine from trailer into 120F and 123F.	020D0008
Pumping vent gas combuster inlet knock out pot.	020D0009
Switching, washing and drying the vent gas combuster flame arresters.	020D0010
Starting, stopping 138JCD diesel caustic scrubber blower and setting up for maintenance.	020D0011
Operating brine filters on primary and secondary brine system.	020D0012
Start up and shutdown of vent gas combuster.	020D0013
Re-establishing brine flows after primary and secondary brine systems have been de-inventoried.	020D0014
De-inventorying primary and secondary brine piping system.	020D0015

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Taking freeze precautions in D area.	020D0016
Making rounds in D area.	020D0017
Pulling and analyzing D area samples.	020D0018
Steps to take in D area in the event of a power failure.	020D0019
Washing packing in the caustic scrubbers.	020D0020
Starting and operating the HVAC system for 101K building.	020D0021
Making up a fresh caustic circulating tank.	020D0022
Setting up 129-C for maintenance.	020D0023
Setting up York condensers for maintenance.	020D0024
Setting up York chillers for maintenance.	020D0025
Taking reading in D area.	020D0026
Dropping back brine and adding performax and antifoam.	020D0027
Pulling and running brine samples.	020D0028
129-L start-up shutdown and operation.	020D0029
Cooling tower operation.	020D0030
Securing brine systems for extended outages.	020D0031

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX G: TABLES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 12: Multicolinearity Table

Variable	Condition Index	Variance Proportions											
		Org Com	Content Validity	Perf. Utility	Learning	Transfer Design	Neg Pers Out	Opp. to Use	Peer Support	Pos Pers Out	Change Resist	Sup. Sanction	Sup. Support
Org Commit	10.5	.00	.00	.00	.00	.00	.01	.00	.00	.01	.13	.04	.00
Content Validity	17.1	.00	.01	.00	.00	.01	.34	.00	.01	.22	.04	.03	.00
Perf Utility	17.2	.00	.00	.00	.00	.00	.25	.00	.00	.62	.00	.00	.00
Learning	21.1	.01	.01	.01	.00	.00	.12	.00	.00	.05	.17	.22	.09
Transfer Design	29.3	.05	.04	.00	.00	.06	.04	.06	.27	.00	.07	.02	.01
Neg Pers Out	31.1	.49	.00	.03	.00	.03	.01	.07	.00	.01	.02	.11	.06
Opp to Use	35.5	.19	.02	.25	.00	.00	.04	.01	.01	.00	.13	.05	.42
Peer Support	42.0	.01	.29	.46	.00	.01	.02	.02	.18	.05	.24	.21	.03
Pos Pers Out	48.1	.05	.41	.17	.00	.01	.00	.46	.06	.04	.00	.09	.23
Change Resist	49.9	.02	.16	.02	.04	.48	.09	.13	.18	.00	.03	.05	.01
Sup Sanction	54.1	.03	.03	.02	.05	.36	.03	.25	.23	.01	.17	.09	.04
Sup Support	180.6	.13	.02	.04	.90	.04	.04	.00	.05	.00	.09	.10	.10

Table 13: One-Tailed Pearson Correlation Coefficient Table

	Perf	Org Com	"Content Validity	Perf Utility	Learn Avg	Transf Design	NegPer Out	Opp to Use	Peer Sup	PosPer Out	Chng Resist	SupSan
Perf												
OrgCom	-.004											
Cont Validity	.20	.43***										
Perf Utility	.07	.42***	.53***									
Learning	-.08	-.15	.01	.13								
Transfer Design	.04	.29**	.69***	.56***	-.13							
NegPer Out	-.11	.28**	.39***	-.27*	.15	.25*						
Opp to Use	.03	.33**	.70***	.58***	-.06	.74***	.38***					
Peer Sup	.22*	.20*	.49***	.55***	-.06	.44***	.17	.45***				
PosPer Out	.13	.12	.21*	.33**	.05	.21*	.19	.22*	.14			
Change Resist	.18	-.21*	-.51***	-.42***	.03	-.44***	-.16	-.45***	-.62***	-.11		
SupSan	.31**	-.14	-.28*	-.47***	-.08	-.32**	-.27**	-.35***	-.45***	-.09	.53***	
SupSup	-.06	.13	.37***	.46***	-.17	.49***	.34**	.54***	.42***	.24*	-.30**	-.54***

* $p \le .05$ (one-tailed) ** $p \le .01$(one-tailed) *** $p \le .001$(one-tailed)

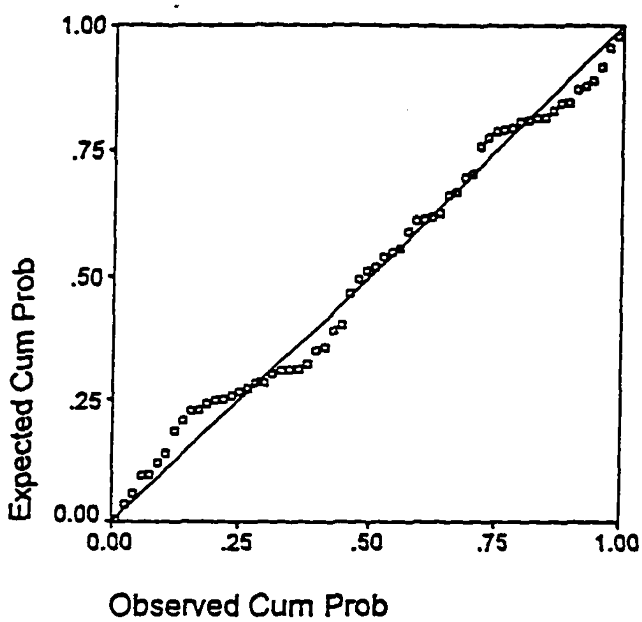
Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX F: DIAGNOSTIC PLOTS

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

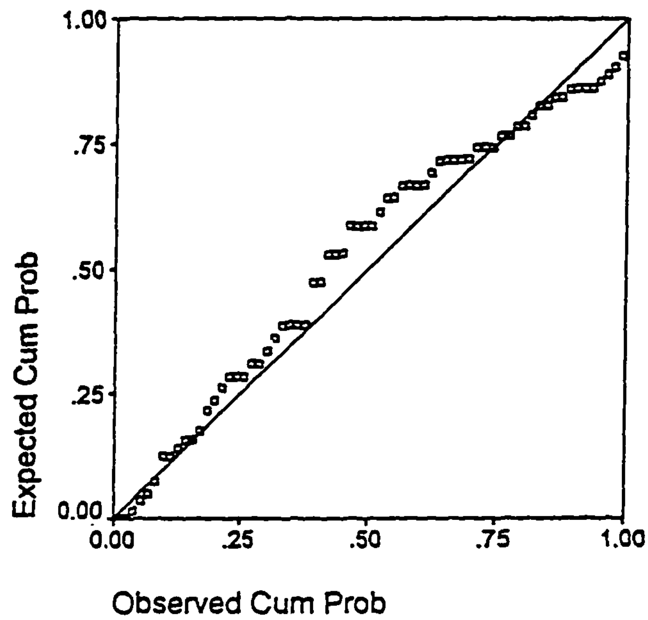
Normal Probability Plot

Dependent Variable: Performance

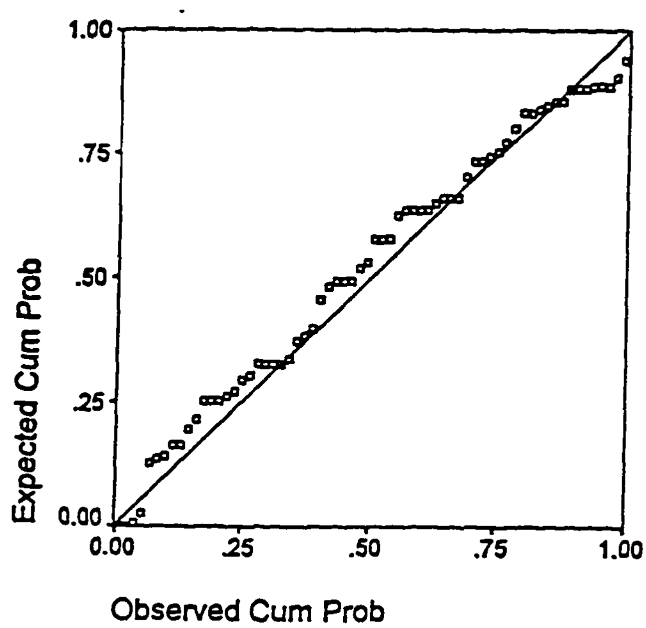


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Change Resistance on Performance

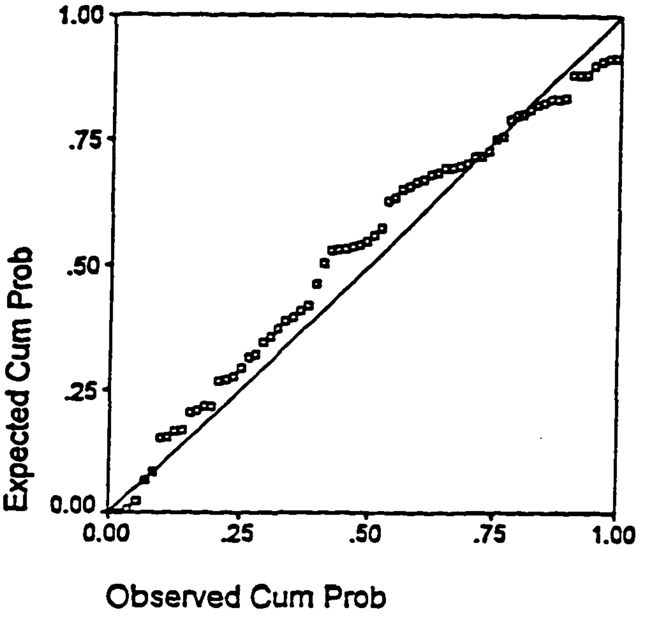


Partial Regression Plot: Content Validity on Performance

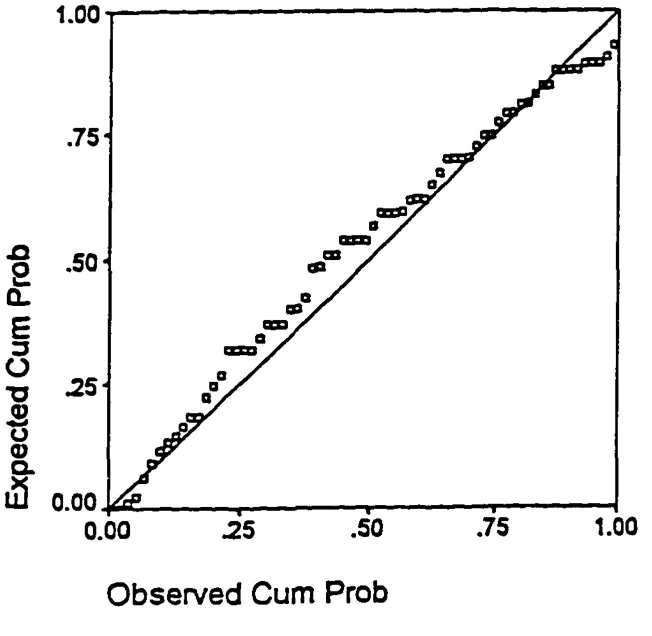


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Learning Average on Performance

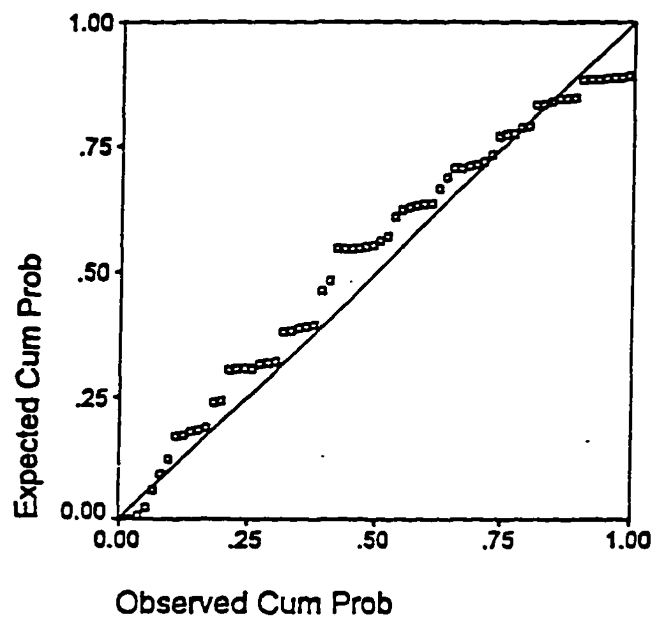


Partial Regression Plot: Negative Personal Outcomes on Performance

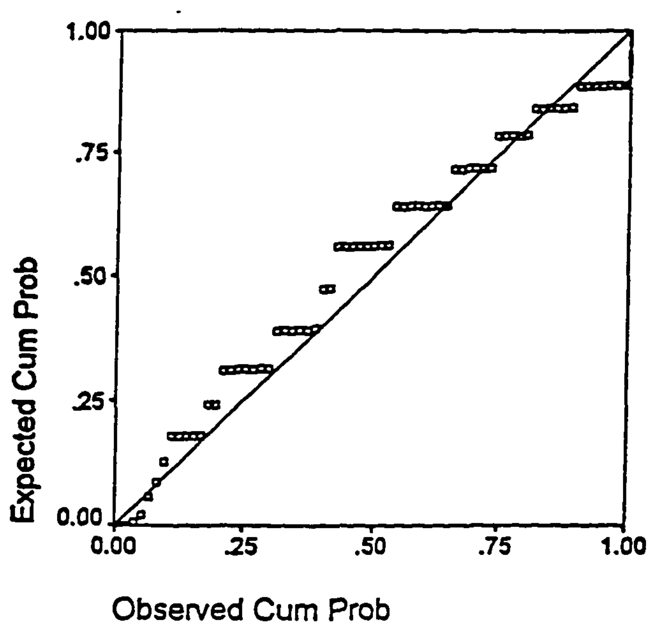


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Opportunity to Use on Performance

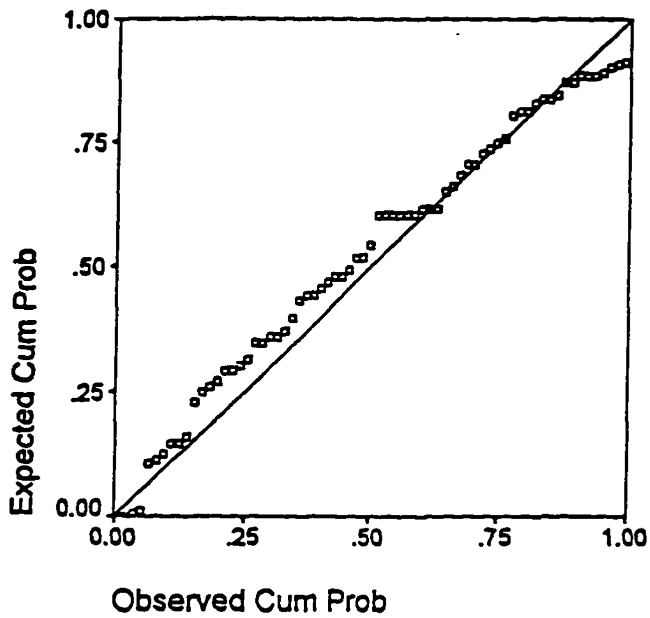


Partial Regression Plot: Organizational Commitment on Performance

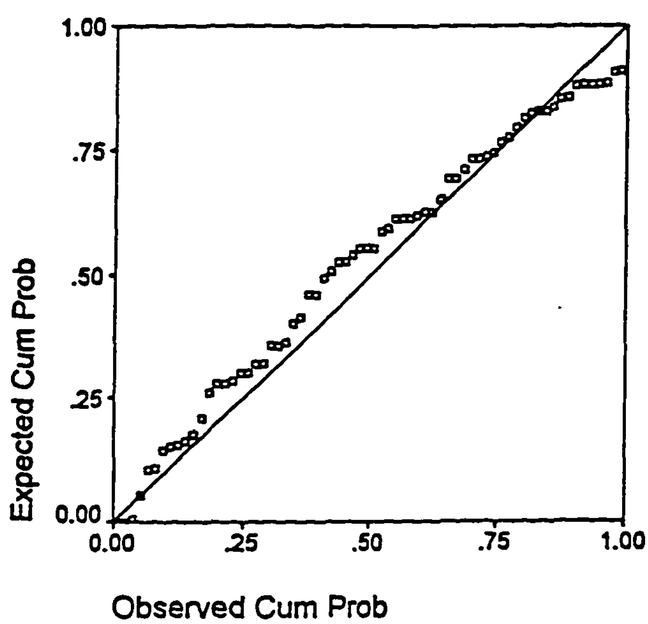


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Peer Support on Performance

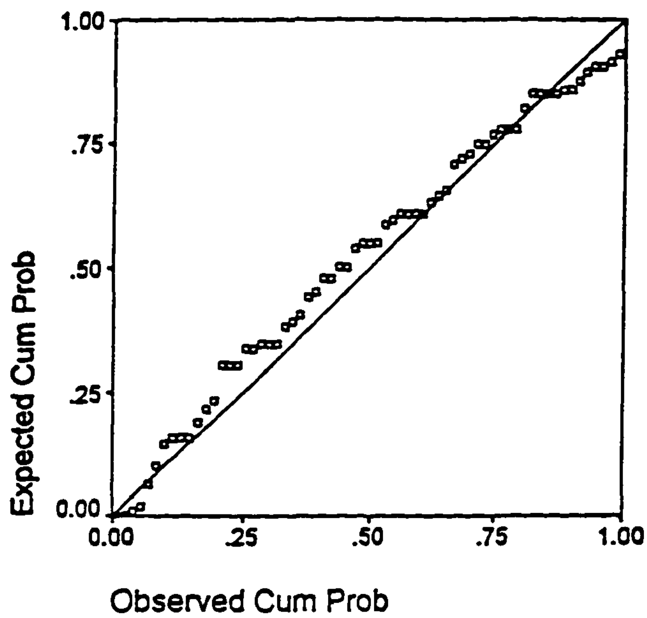


Partial Regression Plot: Performance Utility on Performance

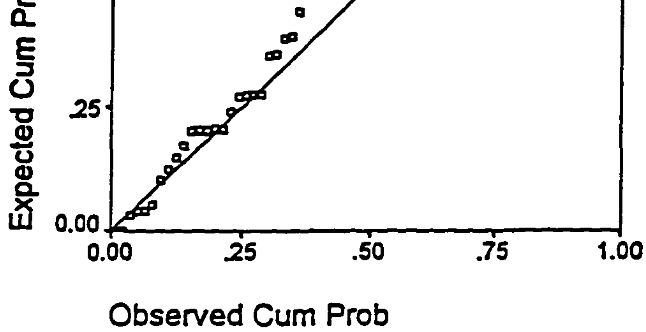


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Positive Personal Outcomes on Performance

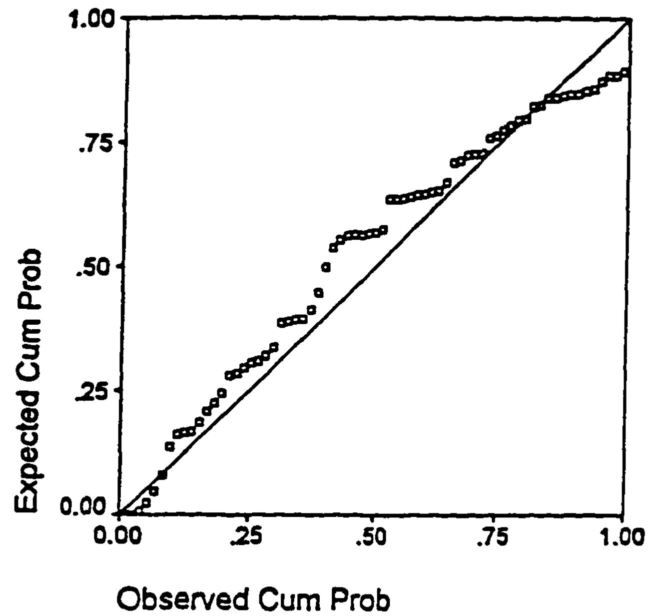


Partial Regression Plot: Supervisor Sanctions on Performance

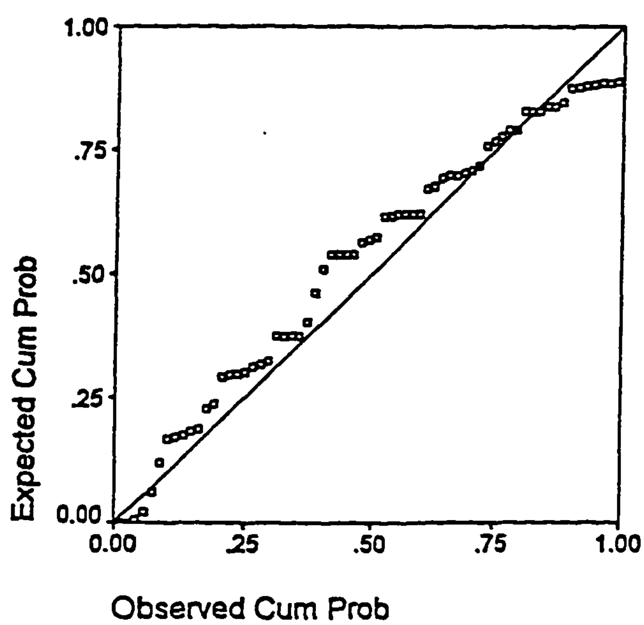


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Regression Plot: Supervisor Support on Performance

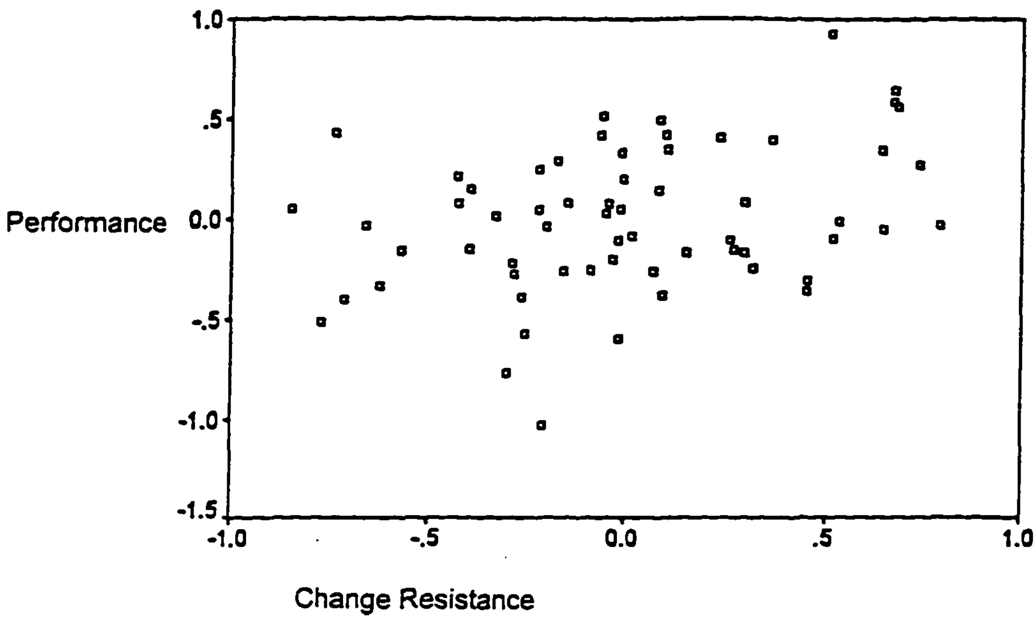


Partial Regression Plot: Transfer Design on Performance

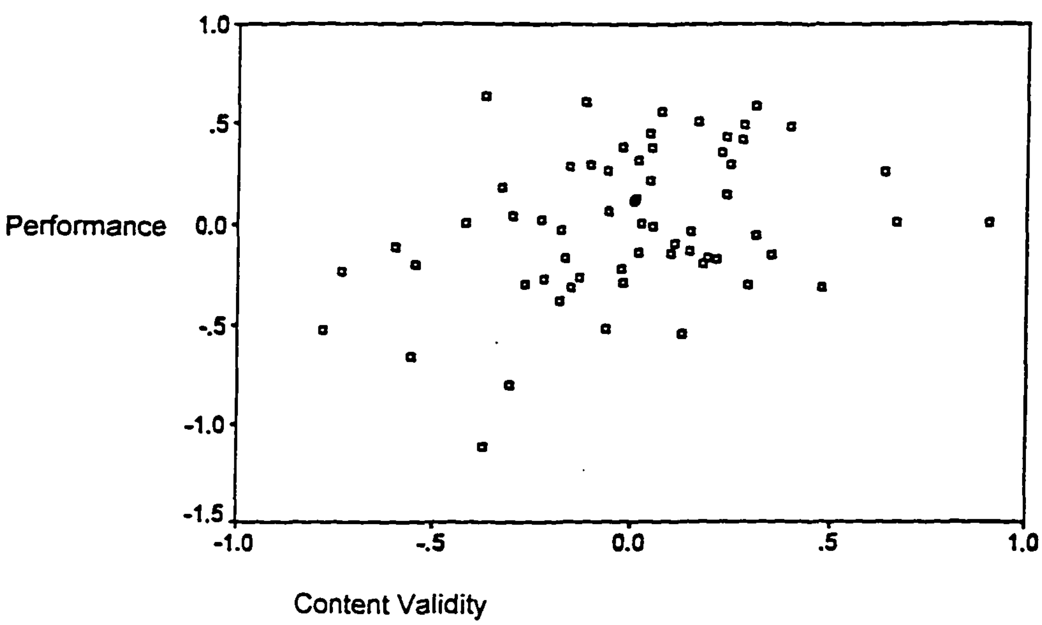


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Change Resistance on Performance

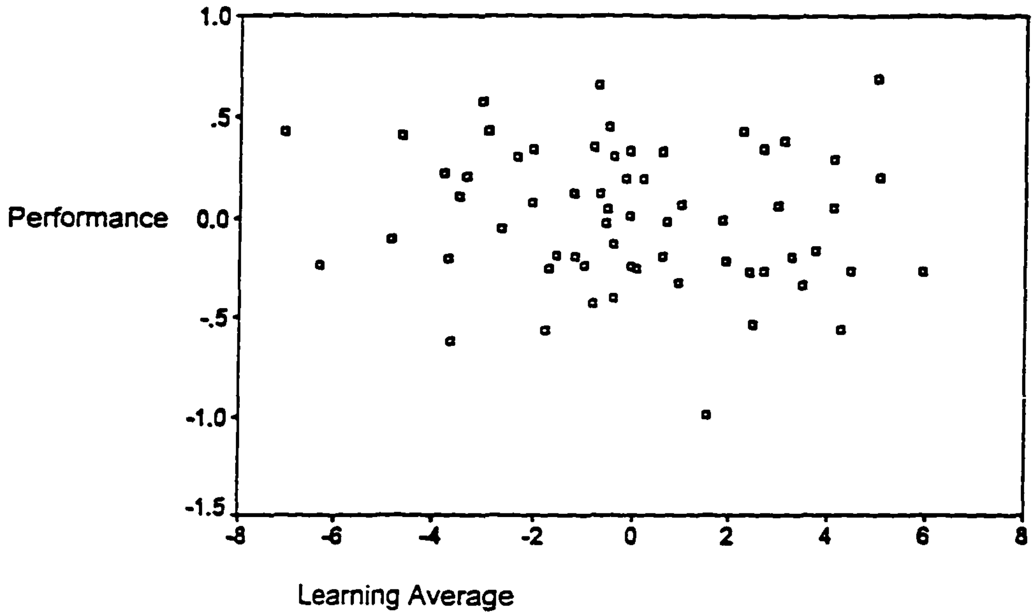


Partial Residual Plot: Content Validity on Performance

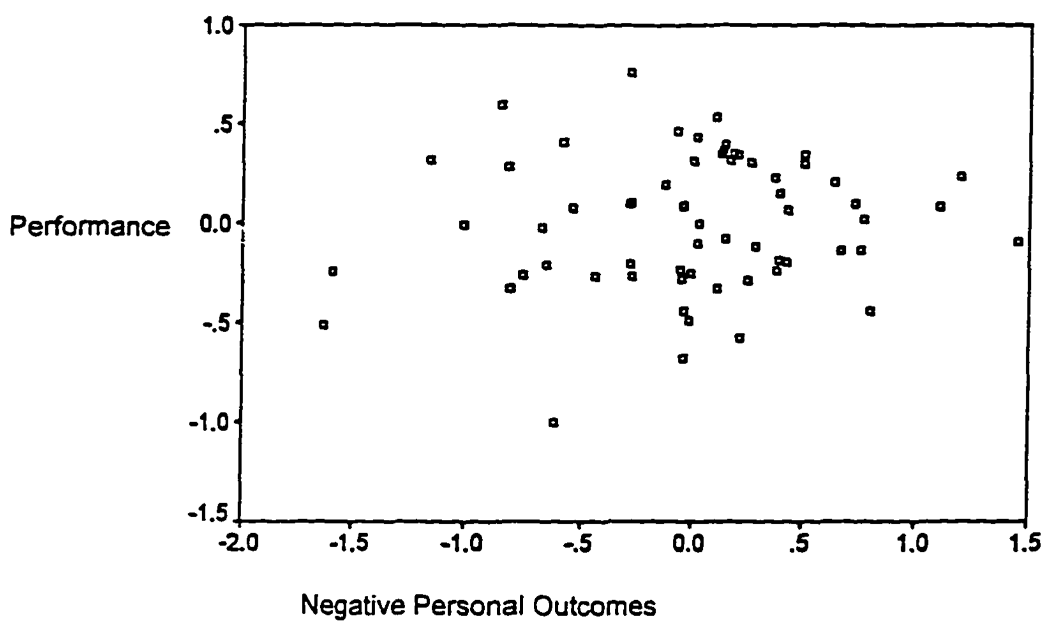


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Learning Average on Performance

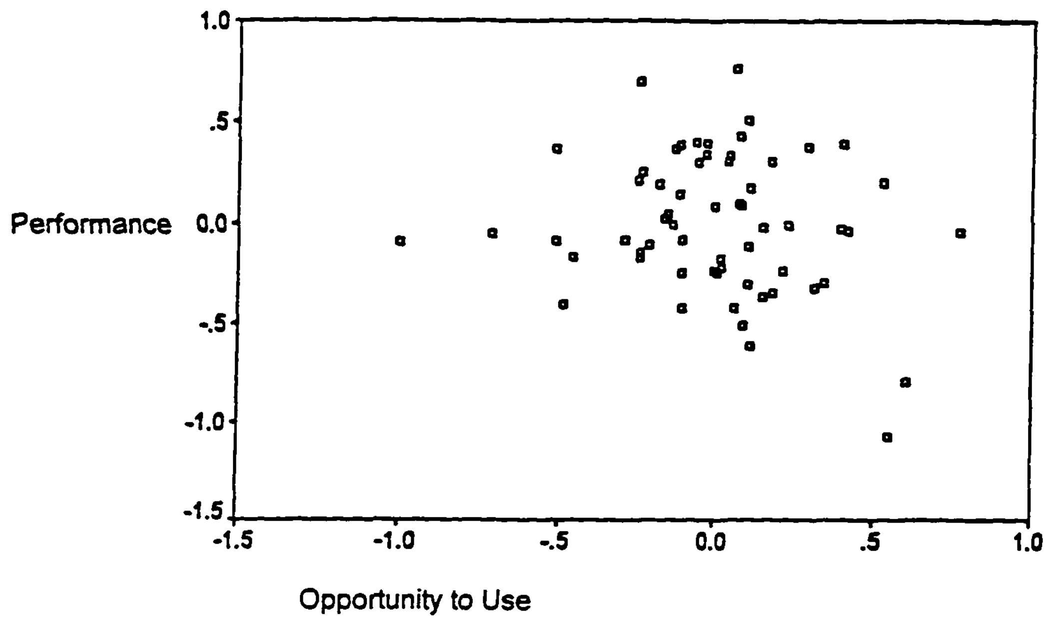


Partial Residual Plot: Negative Personal Outcomes on Performance

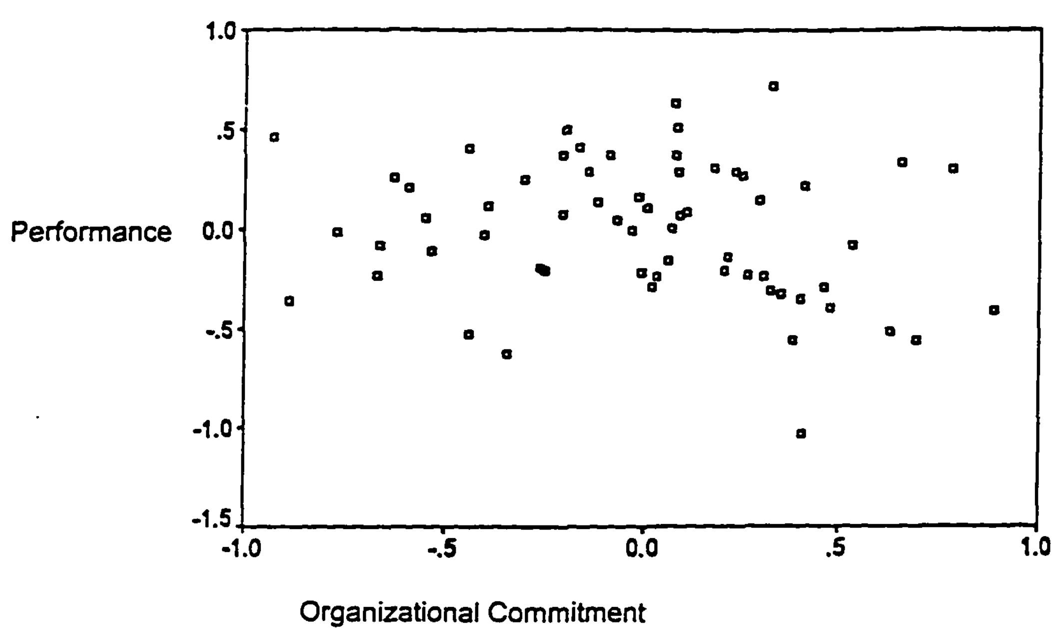


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Opportunity to Use on Performance

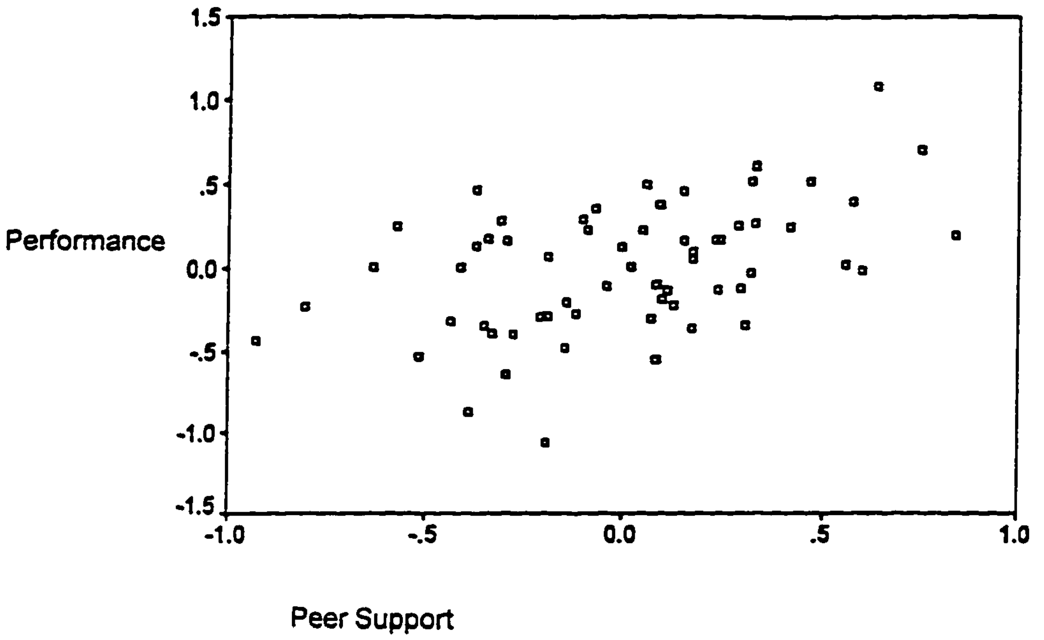


Partial Residual Plot: Organizational Commitment on Performance

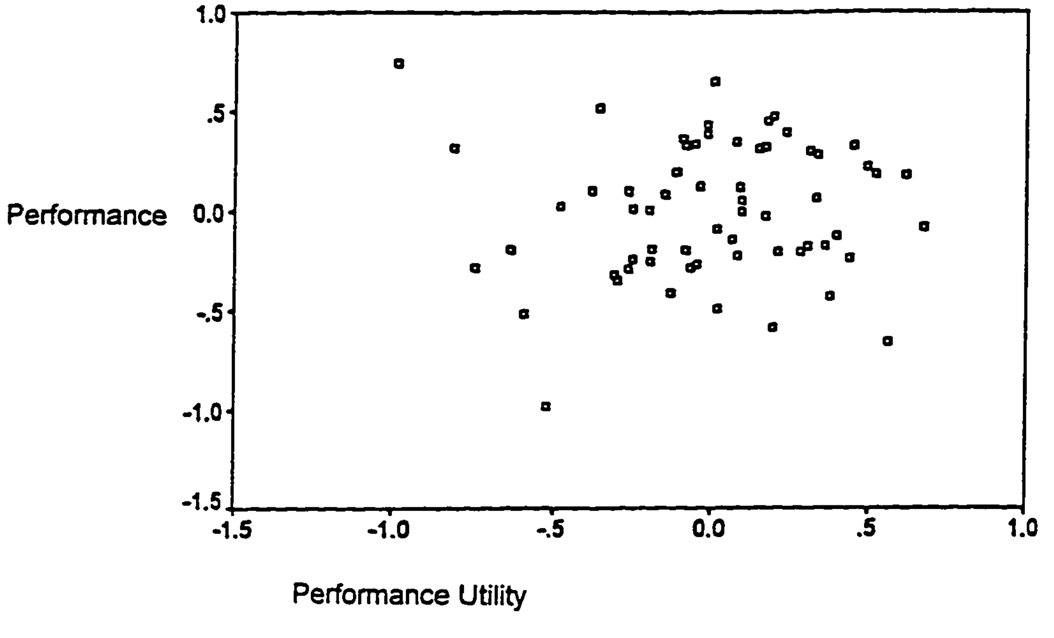


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Peer Support on Performance

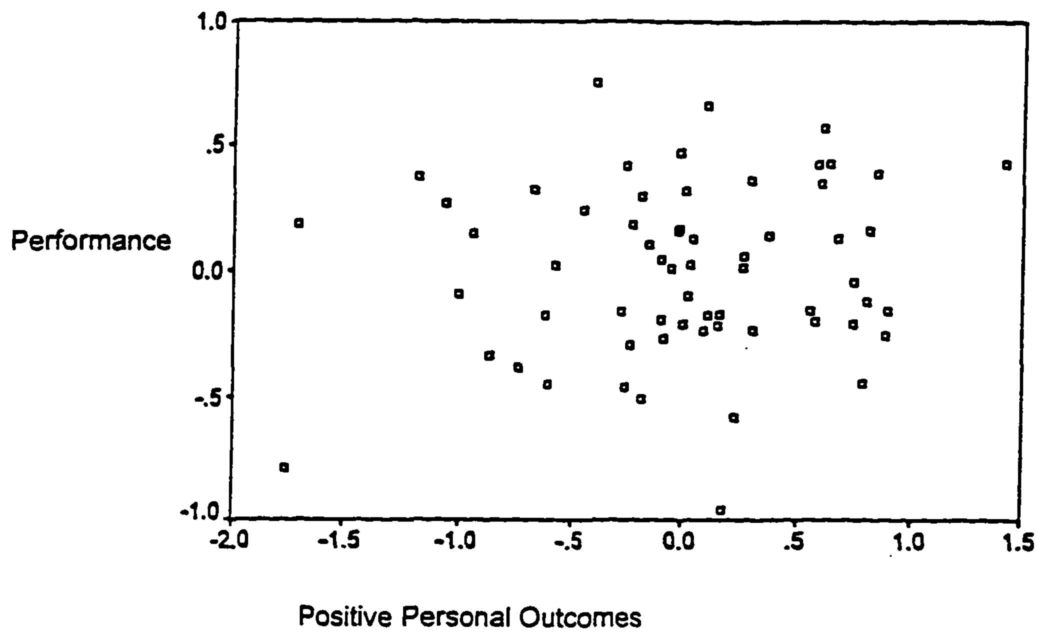


Partial Residual Plot: Performance Utility on Performance

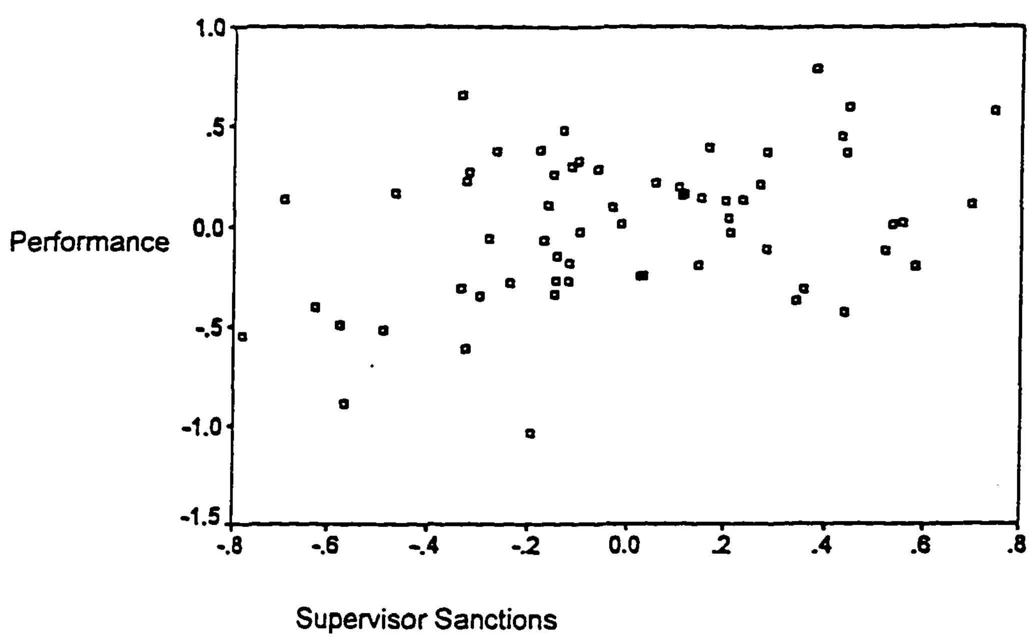


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Positive Personal Outcomes on Performance

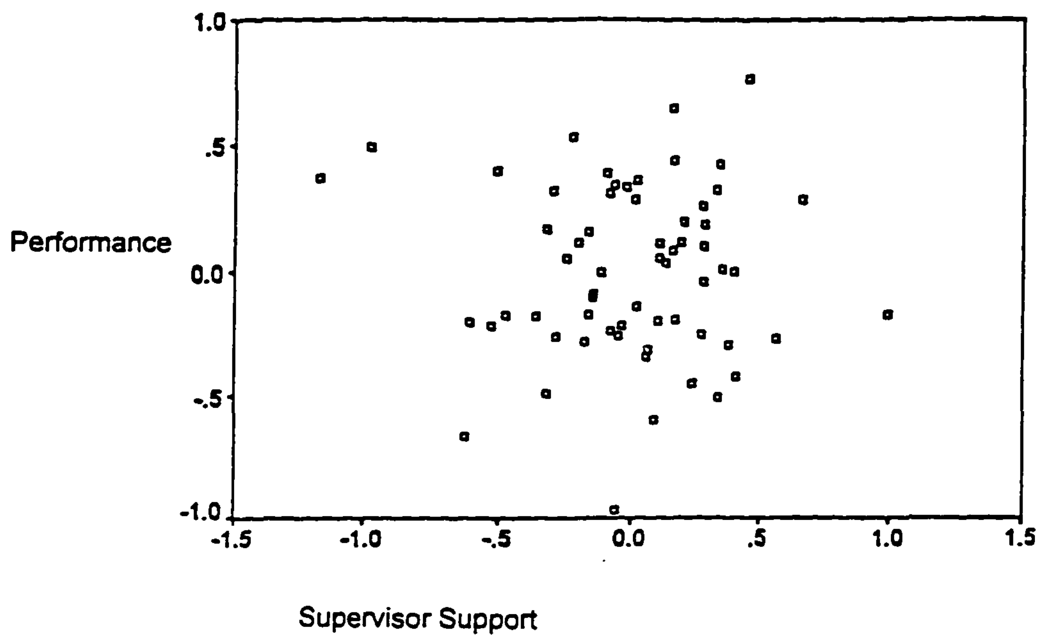


Partial Residual Plot: Supervisor Sanctions on Performance

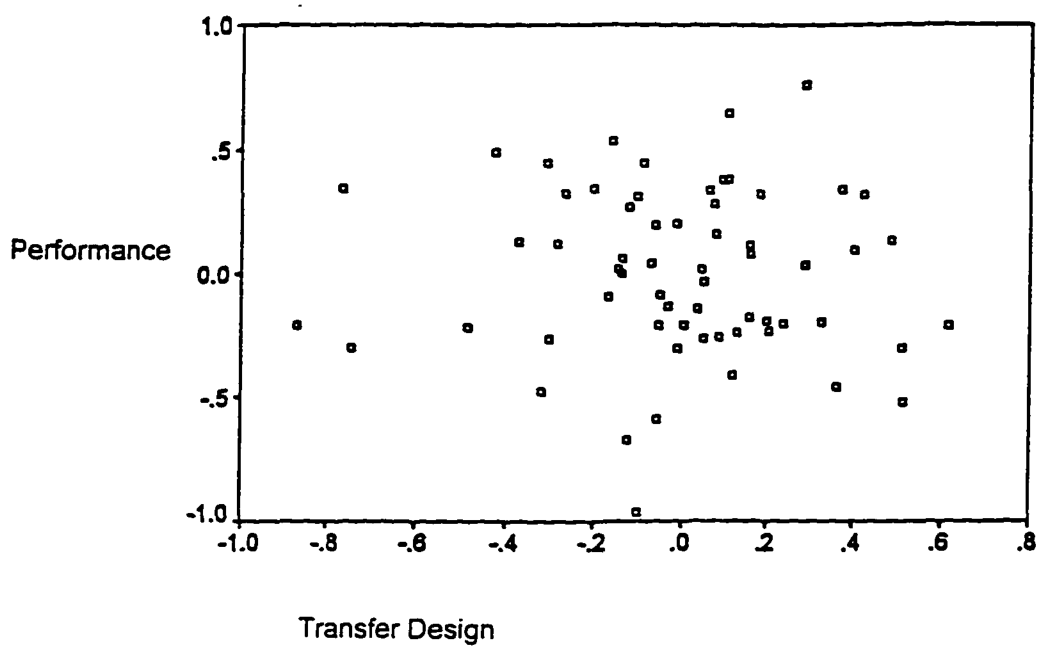


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Partial Residual Plot: Supervisor Support on Performance



Partial Residual Plot: Transfer Design on Performance



Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

VITA

Reid A. Bates holds a bachelors of arts degree in Psychology from the University of Iowa and a masters of science degree in Vocational Education from Oregon State University. Awarded a prestigious Chancellor's Scholarship, a four year full scholarship with stipend, from Louisiana State University, Mr. Bates completed his doctor of philosophy degree in Human Resource Development there in 1997. Mr. Bates has enjoyed a varied work background including experience as a youth counselor, carpenter, cabinetmaking instructor, Peace Corps Volunteer, Training Coordinator for an international training firm, and Director of Vocational Education in a community college. In addition, Mr. Bates has had substantial success working with business, industry, and educational organizations in the United States, Africa, and the Pacific region designing, implementing, and evaluating projects related to adult education and workforce training and development. Mr. Bates has published a number of articles addressing research interests in assessing the performance improvement potential of human resource development interventions, transfer of training, computer-based training, and innovative adult education methodologies. Mr. Bates and his wife, Gwenn Laviolette, live in New Roads, Louisiana, and have a son, Augustus.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Reid A. Bates

Major Field: Vocational Education

Title of Dissertation: The Impact of Training Content Validity, Organizational Commitment, Learning, Performance Utility, and Transfer Climate on Transfer of Training in an Industrial Setting

Approved:

Elwood F. Holton III

Elwood F. Holton III
Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Michael F. Burnett

Michael F. Burnett

Eugene Kennedy

Eugene Kennedy

Donna H. Redmann

Donna H. Redmann

Satish Verma

Satish Verma

Date of Examination:

November 22, 1996

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.